



INDEPENDENT ECONOMIC ANALYSIS OF THE LONG-TERM LIQUEFIED NATURAL GAS IMPORT SOLUTION TO THE REPUBLIC OF LITHUANIA

A report to Klaipėdos nafta

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EXECUTIVE SUMMARY

Pöyry Management Consulting has been commissioned by Klaipėdos nafta to carry out an independent economic cost benefit analysis of continued Liquefied Natural Gas (LNG) supply into Lithuania after 2024.

Lithuania has access to LNG via a Floating Storage and Regasification Unit (FSRU) at the Klaipėda terminal. The terminal facilitates the import of LNG from global suppliers. The FSRU is leased from Høegh LNG on a ten-year lease arrangement that expires in 2024. There is an option to purchase the FSRU or to extend the period of the lease upon expiry of the current arrangements. Alternatively, the FSRU could be returned to Høegh LNG thus ending the capability to import LNG into Lithuania.

In 2012, the decision to develop an LNG import capability into Lithuania was taken to improve the security and diversity of gas supply and to break the monopoly supply position of Gazprom. The decision was taken against a background of high gas prices in Lithuania when compared to the other Baltic States of Latvia and Estonia and to continental European gas markets. LNG imports were seen as an essential way to improve the security of gas supply to Lithuania and also to allow access to global LNG supplies and pricing.

Currently, gas prices in Lithuania are much closer to European price benchmarks than in 2012 and this has been due to a number of factors that include the competitive pressure brought to bear on Gazprom's pricing strategy by alternative LNG supplies, the end of long-term gas supply contracts and the response of Gazprom to the European Commission's anti-trust case.

Implementation of EU Directives and Regulations has started the process of liberalisation of the Baltic States' gas markets, effectively laying the foundations for supply competition to develop. Plans to progress a regional Baltic gas market are underway and this, if successful, should create a larger market area, harmonised market rules and a single trading point. New gas infrastructure is planned to enable the interconnection of Poland to Lithuania enabling access to European gas markets and Finland to Estonia which will potentially create an even larger market area if Finland joins the regional gas market.

The gas market outlook therefore looks very different in 2018 than it did in 2012. However, whilst the introduction of LNG has facilitated more competitive wholesale gas pricing, it has come at some cost to Lithuanian consumers who collectively pay for the LNG terminal via a security of supply levy¹.

The development of Lithuania's energy strategy has identified that the future of LNG needs to be addressed to determine whether it will continue to be beneficial in future.

The analysis has focussed on answering two main questions:

- Are Lithuania's best interests served by having an LNG terminal post 2024?
- If so, what is the optimal economic solution to access the global LNG market?

To address these questions, three options have been considered for the future market structure; Interconnected National Markets, a Baltic Regional Market and a Baltic plus

¹ The security of supply levy includes the FSRU leasing costs and the Designated Supplier costs which are incurred to ensure a minimum operational flow through the terminal.

Finland Regional Market. In each of these market structures the costs and benefits of three commercial FSRU options² have been assessed:

- purchase of the FSRU;
- extension of the lease for a 10 year period to 2034; and
- extension of the lease for a 20 year period to 2044.

In each case, the costs and benefits are compared to a baseline case in which the FSRU lease or purchase option is not taken up and LNG is no longer available to Lithuania. In this case the only non-Russian source of gas available to Lithuania and the region is via the Gas Interconnection Poland Lithuania (GIPL) which is assumed to be operational by 2021/22. A number of gas demand and infrastructure availability sensitivities have also been assessed.

Key Messages

The analysis leads to the following key messages:

- The benefits of maintaining the FSRU outweigh the costs in each of the market structures considered and therefore it is beneficial to Lithuania to keep the FSRU post 2024.
- The main quantifiable benefit of maintaining the FSRU is derived from lower wholesale gas prices when comparing the scenarios 'with' and 'without' LNG.
- The net benefit is highest under the Baltic regional market structure.
- The net benefit is highest when the FSRU is purchased.
- When considering the leasing options, an early renegotiation, before 2024, increases the economic net present value (NPV) as lower annual leasing costs could be achieved.
- Lithuanian consumers will see the maximum benefit of lower wholesale gas prices if a good level of retail supply competition can be established.

Assessment of Costs

The FSRU purchase costs are estimated to be in the region €121 - €160 million based on publicly available information. FSRU purchase costs have been annuitized and fed into the Costs Benefit Analysis (CBA) calculation. An allowance for a future scrappage value of the FSRU has been made.

Leasing costs³ have been provided by KN based on discussions with Höegh LNG and range between €25 and €35 million per annum depending on the length of the lease extension.

Operating costs are similar whether the FSRU is purchased or leased and have been provided to us by KN.

² A number of other infrastructure options have been considered including the construction of an onshore LNG facility, utilising small-scale LNG technology and using an older LNG carrier as a Floating Storage Unit (FSU). Initial analysis of these options shows that they are either not feasible or are not economically attractive when compared to a FSRU. We have therefore not evaluated these options in the CBA.

³ Covering only the annual cost of chartering the vessel.

The Designated Supplier costs make up a significant element of the current cost base. We consider that the current costs can be reduced after the expiry of the LITGAS/Statoil contract. Based on our understanding of premiums in the LNG market, we have assumed that cargoes equivalent to the same annual volume of the LITGAS/Statoil contract⁴ (3.6TWh) would require a premium of €0.85/MWh (\$0.30/mmbtu) above market prices. This represents a substantial cost reduction when compared to the current arrangements.

Assessment of benefits

Assessments of the possible benefits are focussed in three main areas:

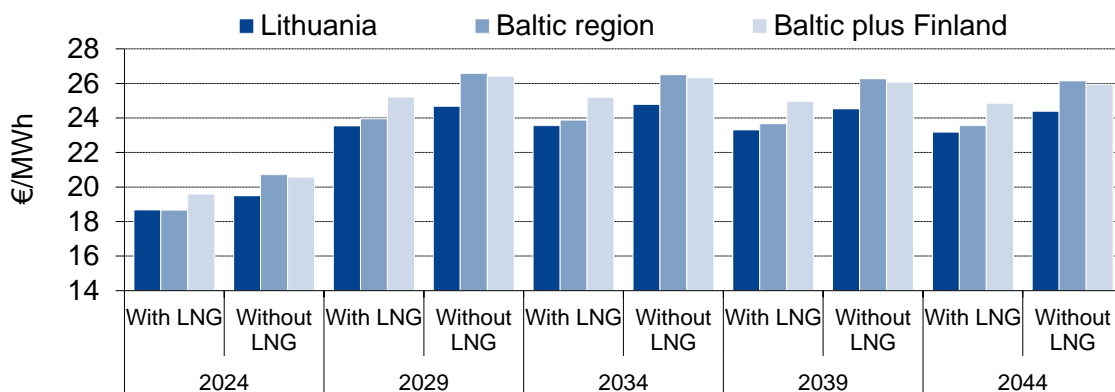
- wholesale gas prices;
- security of supply; and
- small-scale LNG.

Wholesale gas prices

Poyry’s Pegasus3 model has been used to provide wholesale gas price projections under each of the market structures where LNG is available. For scenarios where there is no LNG available, calculation of a market power premium that may be applied to wholesale gas prices has been based on a methodology that assesses the Residual Supplier Index (RSI) and the Lerner Index. This gives a range of premium that can be applied to a competitive market price depending on the level of market power that can be exerted. The potential benefit associated with LNG is derived from the delta between the competitive market price and the market power price. Applying this methodology gives the annual wholesale gas prices shown in Figure 1.

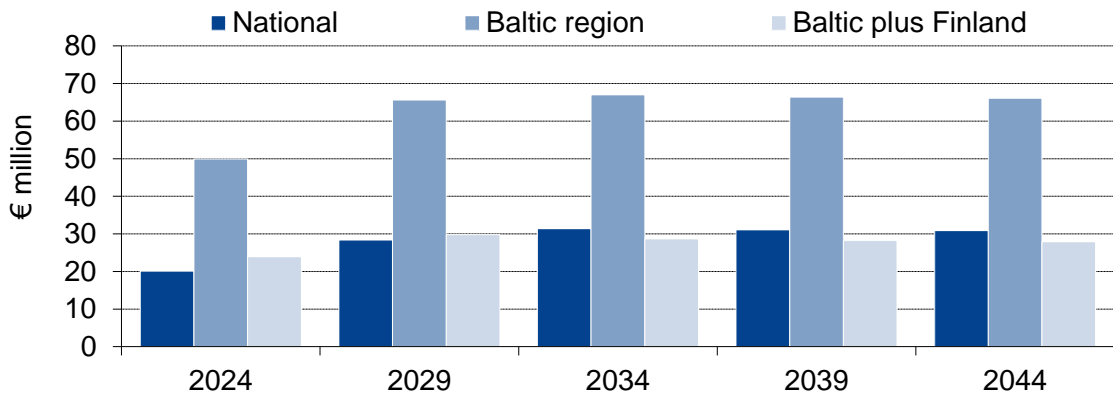
Due to lower wholesale gas prices, LNG supply results in a benefit to Lithuania of between €20 and €60 million a year as shown in Figure 2. This benefit is calculated by multiplying the price delta by Lithuanian gas demand.

Figure 1 – Annual wholesale gas market prices with and without LNG



⁴ <http://www.litgas.lt/en/litgas-and-statoil-have-signed-the-amended-baseload-supply-agreement/>

Figure 2 – Annual benefits resulting from lower wholesale gas price in Lithuania



Security of supply

Three security of supply scenarios have been assessed:

- an interruption to all Russian supplies into the region;
- an interruption to the Inčukalns storage facility; and
- an interruption of Russian supplies via Belarus.

Results show that an interruption to all Russian supplies into the region would have a significant effect, and therefore the benefit of retaining LNG in such a case is significant. However, the impact in the other cases is much more muted. As a result, once the probabilities of such an event occurring is factored into the CBA, the overall benefit that LNG adds to security of supply is small. This result would be substantially different if GIPL is not developed.

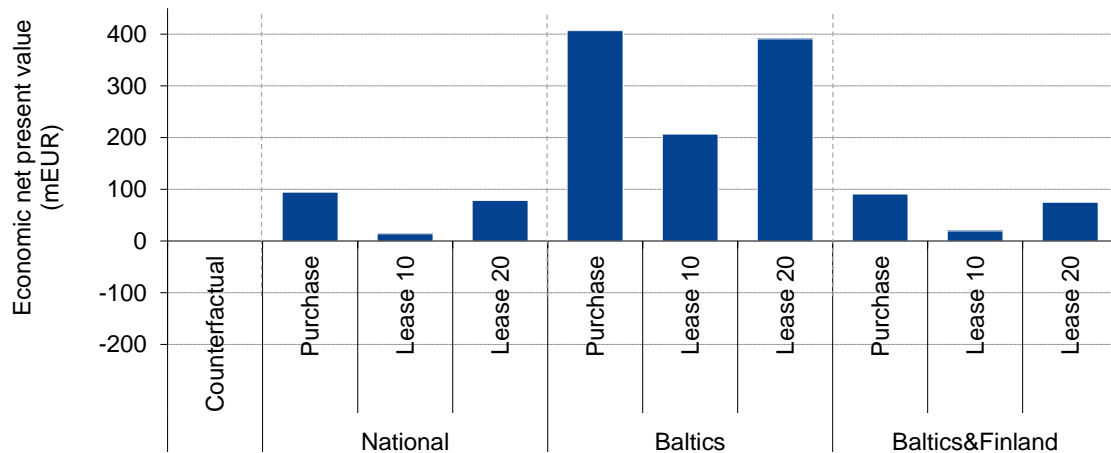
Small-scale LNG

The potential benefit of a reloading service for small-scale LNG at Klaipeda is based on the capacity of ssLNG ports existing and planned around the Baltic region and project a minimum throughput. The resulting benefit to Klaipeda of the reloading ssLNG market is in the range of €2.7 to €5.5 million a year.

CBA Results

The results of the main scenarios considered within this report are illustrated in Figure 3. The results show that in all such cases evaluated, there is a net economic benefit for Lithuania from retaining access to LNG after 2024 when compared with the counterfactual case in which there is no LNG.

Figure 3 – Economic net present value for Lithuania



The analysis shows that the greatest net economic benefit is achieved in all market structures when a FSRU is purchased. The net economic benefit of purchasing is closely followed by leasing a vessel for a further 20 year period. This is shown in Table 1.

Table 1 – Economic net present value for Lithuania (€m)

Option	National markets	Baltic market	Baltics & Finland
Purchase	94.4	406.5	90.8
Lease 10	14.0	206.8	19.6
Lease 20	78.5	390.6	74.9

A number of sensitivities to these results shows that the net economic benefit is increased in the event of an early (i.e. pre-2025) purchase of an FRSU alongside renegotiated annual payments. The sensitivities also show that the results are sensitive to the overall level of gas demand in Lithuania as well as whether GIPL is developed or not.

Conclusions

- Lithuania should retain access to LNG after 2024 since there is a net economic benefit.
- The optimal value is achieved by purchasing a FSRU regardless of which market structure is assumed.
- Purchasing the FSRU comes with some risks – in particular the net economic benefit does not exceed that of the leasing options until close to the end of the time horizon. However, in our view, the purchase of the FSRU provides Lithuania with the most flexibility to react to unexpected circumstances (for example falling gas demand) since the FSRU can be sold if required, whereas a long-term lease is an inflexible solution (unless sufficient flexibility can be agreed, e.g. break clauses).
- Analysis shows that purchase or lease of a smaller vessel is unlikely to result in substantial savings in cost, and would be a logistically inferior solution to purchase of a 170,000m³ vessel.

- Retaining access to LNG also brings a range of qualitative benefits, not least diversity of supply sources which will be essential to ensuring the development of a functional wholesale market in Lithuania.

1. BACKGROUND

1.1 The gas market in Lithuania

Whilst the Lithuanian gas market is small by European standards, with an annual consumption of around 2.3bcm/annum, it plays an important role in the supply of gas to the Baltic region, providing the only non-Russian source of gas into the region.

The Lithuanian gas market is liberalised and complies with the unbundling (and other) requirements of the Third Energy Package. Lithuania is connected to its neighbour Latvia, which itself has liberalised since 2017 and has access to its Inčukalns storage facility. The Estonian market, which is connected to Latvia, has also liberalised and together the three Baltic States are working toward the creation of a regional market in 2019/20. It is possible that Finland may join the regional market to create a Baltic plus Finland region.

Up until the commissioning of the Klaipeda LNG terminal in 2014, the Lithuanian gas market was supplied solely by Russian gas purchased from Gazprom under long-term contracts and when necessary via the Inčukalns gas storage facility.

The market situation in Lithuania has developed considerably since 2012 when the decision to invest in LNG was made. Annex A compares differences in the Lithuanian gas market in 2012, 2018 and into the future.

Gas demand

Whilst gas demand in Lithuania has reduced over recent years, largely due to natural gas being replaced by biomass in district heating, it is now expected to stabilise. The consumer market is split into the wholesale market (which refers to consumers consuming in excess of 600 GWh per annum) and the retail market. There are 15 large consumers in the wholesale market and over 560,000 consumers in the retail market. This is summarised in Table 2. Achema – a fertiliser producer – is the largest single consumer representing almost 50% of total Lithuanian gas demand that supplies gas to its own site. Lietuvos Dujų Tiekimas (LDT) and LITGAS dominate the retail market with supply to around 99% of the market.

Table 2 – Consumer segments and consumption 2016 (GWh)

	No. of consumers	Consumption (GWh)
Wholesale		
Large consumers >600GWh	15	20,095
Retail		
Household	566,000	1,881
Non-household	6,800	5,184

Source: NCC: Annual report to EC 2017

The Lithuanian transmission grid, operated by Amber Grid, is an important transit route for Russian gas that is transported to Kaliningrad and transit volumes accounted for over 23,500 GWh in 2016.

Klaipeda LNG

The Klaipeda LNG terminal has been operated by Klaipėdos nafta (KN) since 2014, when it was commissioned. To date, the purchasers of LNG are LDT, LITGAS and Achema as shown in Table 3 and each is responsible for its own contractual arrangements with LNG suppliers to the terminal (though on occasion there is cooperation to share cargoes, though each party remains responsible for its own commercial terms). These three companies are also the largest suppliers to consumers in Lithuania.

Table 3 – LNG import volumes by buyer and resulting terminal utilisation

Buyer	2014 mcm	2015 mcm	2016 mcm	2017 mcm	Total mcm
Achema	-	-	-	84	84
Achema LDT LITGAS	-	-	599	-	599
Achema LITGAS	-	-	428	488	916
LDT	-	-	-	345	345
LITGAS	149	436	342	182	1,109
	149	436	1,369	1,100	3,054
Utilisation (max 4bcm)	-	11%	34%	27%	

Source: ICIS LNG Edge, Pöyry analysis

LITGAS is the Designated Supplier of LNG, responsible for ensuring that sufficient LNG cargoes are delivered to the terminal in order to keep it operational. To date this has been around 3.5 - 4 cargoes per year. LNG is supplied by Statoil under a 10-year contract which runs from 2014 to 2024. LITGAS sells regasified natural gas in the market to specific customers at prices that are regulated by the National Commission for Energy and the Control of Prices (NCC). Any difference between the sale price of the gas and the purchase price of the LNG is treated as a cost that is recovered from all gas consumers in Lithuania.

Achema uses natural gas as a feedstock in fertiliser production and is therefore commercially driven in its gas procurement. It began importing LNG in 2015 and in 2016 signed a 3 year supply contract with Statoil.

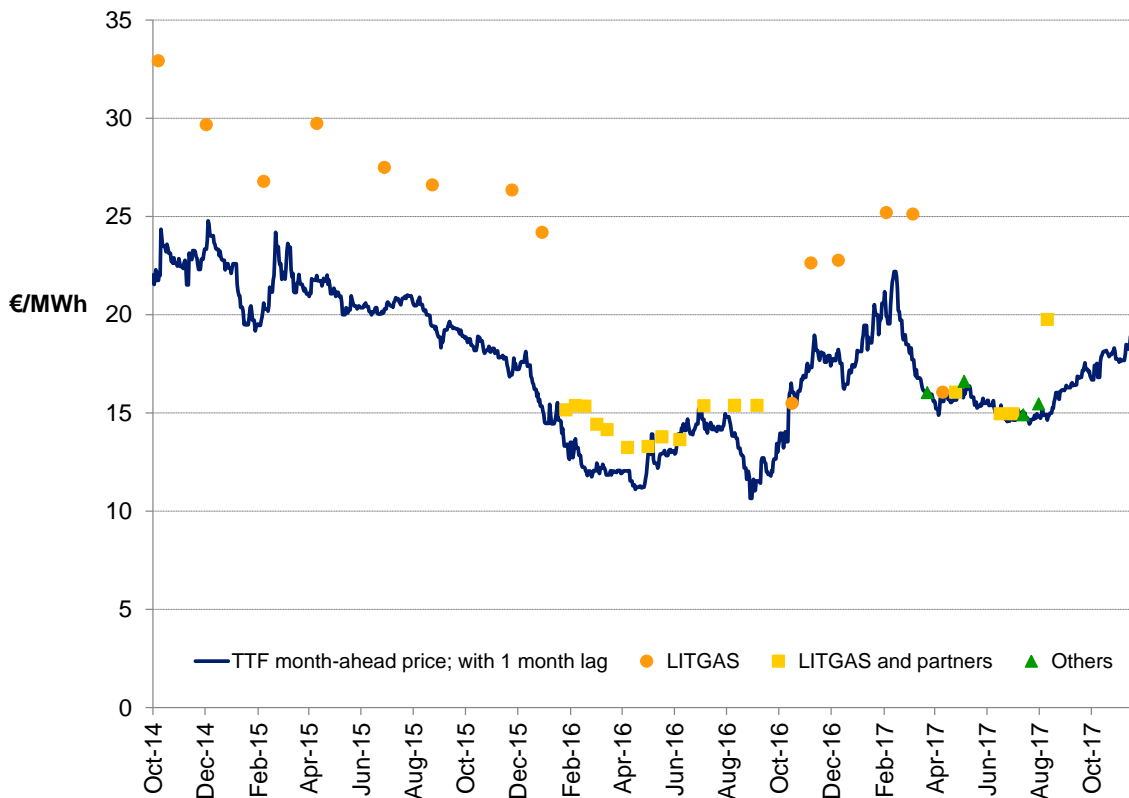
LDT is the biggest gas supplier in Lithuania in terms of customer numbers supplying more than 560,000 households and more than 6,000 commercial. It is part of Lietuvos Energija group which is state owned and was established following the unbundling of the incumbent integrated energy company Lietuvos Dujos. LDT sources LNG from the spot market and also has a commercially driven purchasing strategy. Since May 2016, LDT has taken delivery of 7 cargoes from a number of different suppliers and source countries.

Utilisation of the LNG terminal has ranged from 11% in 2015 (first full year of operations) to 27% in 2017. Klaipeda has seen its highest levels of utilisation in periods when continental European hub prices have been low. Due to its role as the Designated Supplier, LITGAS has imported cargoes reasonably consistently over the period of operations, but the ‘commercial’ shippers (LDT and Achema – shown as ‘Others’) imported far more cargoes when prices were low in summer 2016 and summer 2017 rather than during the respective winter seasons.

Figure 4 shows that several importers have achieved LNG prices that are in many cases close to parity with TTF, or at a very small premium. By contrast, it is apparent that when LITGAS takes cargoes alone, that these purchases represent a very large premium to the

wholesale hub (presumably reflecting the terms of agreement with Statoil) and thus result in a large cost which needs to be borne by the consumers.

Figure 4 – LNG prices compared to TTF⁵

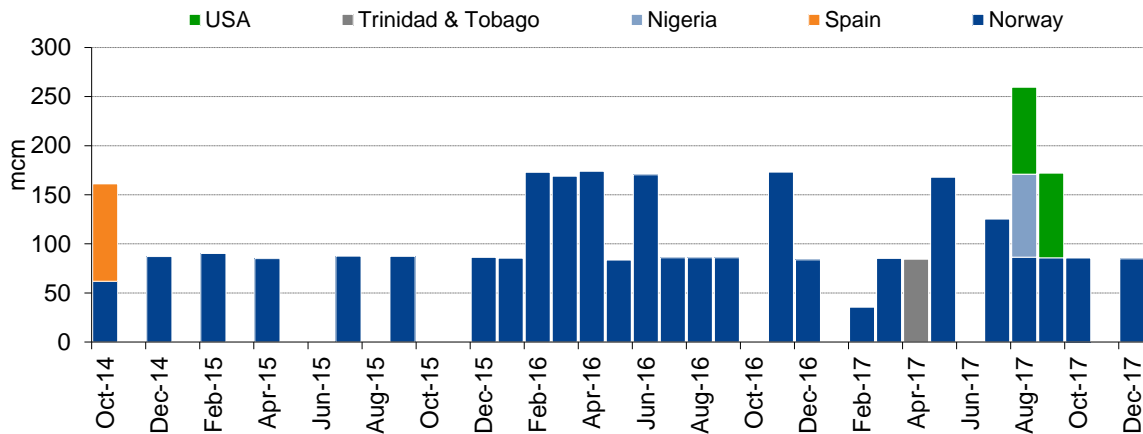


Source: ICIS, ICIS LNG Edge, Pöyry analysis

Cargoes have been delivered from a number of sources, including the USA, but most originate from Norway as shown in Figure 5.

⁵ For illustrative purposes, within this chart we plot the delivered LNG prices compared with the month-ahead price quoted one month prior to the arrival date of the cargo. This is a simple proxy which appears to explain the relationship reasonably well, but is not intended to imply that this is how such cargoes have been priced.

Figure 5 – Deliveries to Klaipeda LNG terminal by source



Source: ICIS LNG Edge, Pöyry analysis

In 2017 commercial reloading and truck loading services have been added to the offering at Klaipeda and this has opened a potential source of new customers for the terminal.

Pipeline gas

Both LDT and Achema continue to buy pipeline gas from Gazprom under annual contracts and arrange LNG imports when the price is commercially attractive compared to the price of pipeline gas from Russia.

LDT’s long-term supply contract with Gazprom expired at the end of 2015 and they have since negotiated further supplies on a short-term basis.

Wholesale gas prices

Prior to the decision to invest in the LNG terminal, wholesale gas prices in Lithuania were higher than in both Estonia and Latvia as well as being significantly higher than prices elsewhere in the EU. The average import price to Lithuania, based on information published by the NCC, is shown in Figure 6.

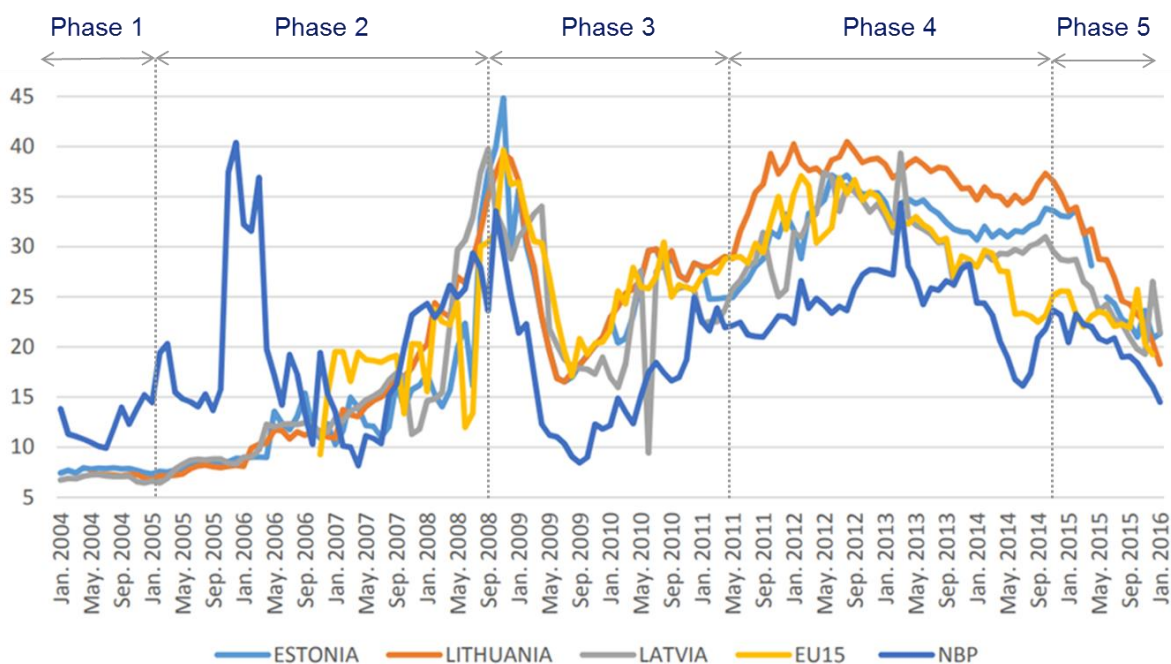
In September 2016, a research paper by the Oxford Institute of Energy Studies⁶ (OIES) detailed the connection between a rise in Russian supplied gas prices to Lithuania and the process of liberalisation of the gas market. It also compared the import price in Lithuania to those in Estonia, Latvia, the National Balancing Point (NBP) in the UK and an EU-15 price. From the OIES analysis it is possible to determine 5 phases in the development of Lithuanian gas prices:

- Phase 1, pre 2005 – prices in all the Baltic States are very similar and much lower than the NBP (and also less volatile).

⁶ Oxford Institute of Energy Studies, Lithuania’s Strategic Use of EU Energy Policy Tools: A Transformation of Gas Dynamics, September 2016. <https://www.oxfordenergy.org/publications/lithuanias-strategic-use-eu-energy-policy-tools-transformation-gas-market-dynamics/>

- Phase 2, 2005 to 2008 – prices in the Baltic States rise steadily following Gazprom’s stated aim of aligning Baltic gas prices with the rest of Europe (following the Baltic States joining the EU).
- Phase 3, 2008 to 2011 – prices in the Baltic States are broadly in line with EU-15 prices.
- Phase 4, mid 2011 to 2015 – the gas price in Lithuania diverges from those in Estonia and Latvia and remains significantly higher for the period. According to OIES, this was largely due to discounts offered to both Latvia and Estonia, but not to Lithuania as it was progressing with implementation of the Third Energy Package.
- Phase 5, 2015 to 2016 – the gas price in Lithuania reduces significantly and becomes aligned once more with the prices in Estonia, Latvia and EU-15, following a 20% discount offered by Gazprom. This coincides not only with the commencement of LNG deliveries in Lithuania but also a pending gas price renegotiation proceedings brought by LDT against Gazprom.

Figure 6 – OIES estimates of Russian gas import, NBP and EU15 prices (€/MWh)



Source: OIES and Pöyry analysis

Gazprom’s contractual pricing strategy is clearly an important factor in the region’s gas price formation. Whilst some of the reductions in gas prices seen over the period will be due to reductions in oil prices and successful contract renegotiations, Gazprom does retain some flexibility to alter its prices to maintain market share. We consider that this will remain a feature of the market into the future.

For this study, it is important to determine whether the ability to import LNG into the market (or gas from Poland in the future) will maintain a competitive pressure on Gazprom by effectively capping the price (at the LNG import price) at which it sells gas into the region.

1.2 Future development of the gas market in Lithuania and the Baltic region

The gas markets in the Baltic States have developed separately over the past few years and have adopted different liberalisation and unbundling timescales. However, as of April 2017, with the liberalisation of the Latvian gas market, the gas markets in each of the Baltic States are, at least in theory, competitive.

Plans are progressing to create a regional gas market from 2019/20, based on a single entry/exit zone with a harmonised entry tariff and a single Virtual Trading Point (VTP). As an interim measure, it is now possible for implicit capacity allocation to take place at the Interconnection Points (IPs) between Lithuania and Latvia and also between Latvia and Estonia if gas is traded on the GET Baltic exchange.

A regional market, once in place, will make the transportation of gas from entry points to offtakes much easier for market participants and should encourage greater liquidity at a single trading point. For example, it will be possible for LNG to be purchased and delivered to a customer in Estonia without incurring transportation charges at each of the national border points.

The timetable for the implementation of the regional gas market is ambitious and until plans are more fully developed there will be a degree of uncertainty. In this study we have developed three main scenarios to account for the different options that may be implemented.

The commissioning of the Balticconnector, between Estonia and Finland, expected in 2020 will create a larger potential market for LNG as it will be possible to transport gas from Lithuania to meet gas demand in Finland. The possibility of Finland joining the regional market will create further trading opportunities for market participants and create a larger market with a greater potential for the development of liquidity.

A gas pipeline link between Poland and Lithuania (GIPL) which is planned to be in place in 2021 will create both an additional gas sourcing option into the region as well as further potential demand for LNG.

1.3 The global LNG market

The growth in LNG has been dramatic in the last 10-15 years and has transformed the global gas market. LNG allows gas to be delivered to new markets that have insufficient indigenous sources of gas and are too far away from a source of gas to make pipeline investment attractive. Similarly, it allows those countries that have an excess of indigenous gas production over domestic demand e.g. Qatar, Australia, U.S. to supply gas economically. LNG can also deliver benefits to countries that may be reliant on a single supplier increasing security and diversity of supply and leading to more competitive gas pricing.

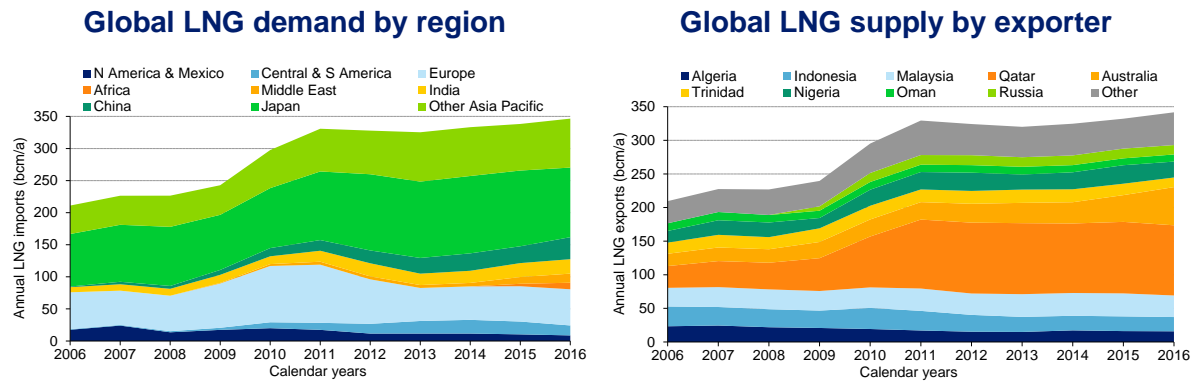
The number of countries importing LNG has grown from 15 in 2005 to 39 in 2016⁷. Figure 7 illustrates in which countries and regions LNG demand has grown. Asia Pacific and Europe are the major importing regions, whilst China and India have shown sustained growth over the last decade. It also shows that Qatar has become a significant producer of LNG in the last ten years. Australia has also shown recent growth in exports with the

⁷ 'Gas 2017 – Analysis and Forecasts to 2022', IEA July 2017.

commissioning of new liquefaction capacity (with more capacity to follow), and the supply picture will change further with a raft of new LNG supply from the United States scheduled to come on-stream between now and 2022.

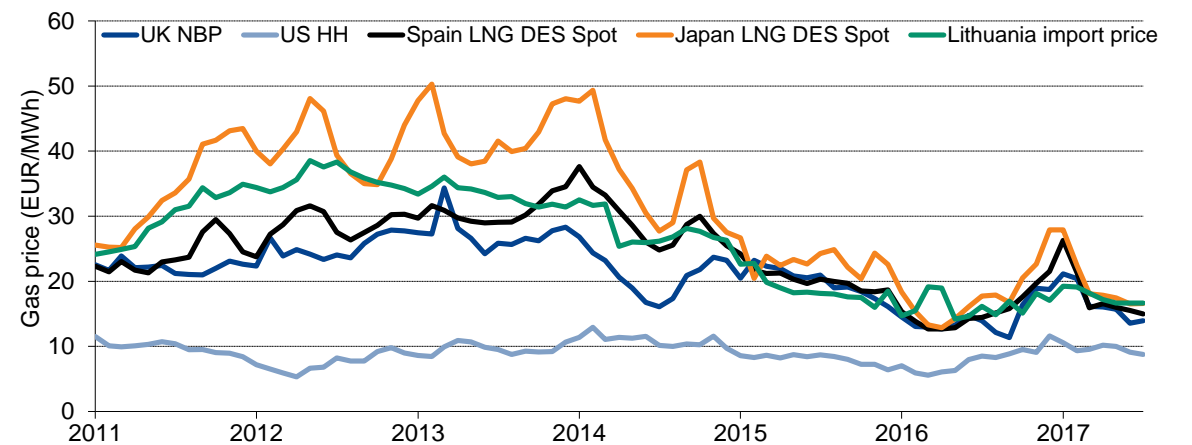
Prior to 2015 there was a significant regional divergence in gas prices as shown in Figure 8. Since 2015, gas prices in most markets, other than the US, have converged, although very recently a premium in Far Eastern gas price has emerged once more.

Figure 7 – Global LNG historical supply and demand (bcm/a)



Source: BP Statistical Review of World Energy 2017

Figure 8 – Historical spot LNG and hub natural gas prices



Source: ICIS Heren, Reuters, NCC

Future development

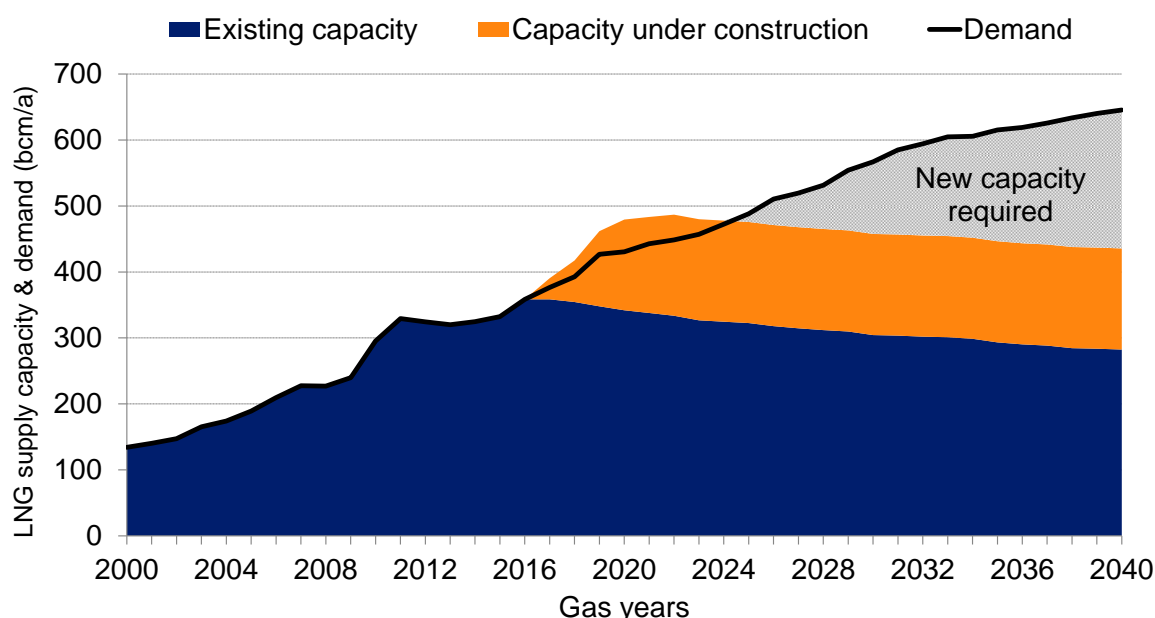
We expect LNG demand to grow significantly in the Chinese and Indian markets as Far East Asian demand growth slows. Overall LNG demand will increase and European LNG buyers must be prepared to compete for new gas supplies, at potentially higher prices compared to today.

The Middle East (driven mainly by Qatar) will continue to be the world’s major LNG exporting region in the long term, but capacity expansions from Australia and the United

States in the near-to-medium term, and from Russia and East Africa in the long term, will limit its share of the global market to a quarter by 2040 (compared to over a third in 2016).

Our projections for the LNG supply-demand balance are shown in Figure 9 and show a substantial increase in global LNG supply in the near term. Most of this supply growth is driven by capacity additions in Australia and the United States. Added to this, there has been a significant slowdown in LNG demand growth, particularly in the major demand centre of East Asia, which is expected to continue into the early 2020s. As much of this new build capacity (and the contracts securing the offtake of the LNG from them) was agreed in the period 2012-2014 and destined for delivery to Asia, an overhang in global LNG supply is widely expected. Assuming all liquefaction capacity is available and not constrained (by feedgas issues or outages), we project the supply overhang to unwind by 2024, coinciding with the start of the analysis period for this study.

Figure 9 – Global LNG supply-demand balance (Central scenario)



After 2024, LNG demand will exceed capacity currently in operation or under construction; hence there will be the requirement for new LNG supply capacity. Given that the period between FID being taken and the start of commercial operations for an onshore liquefaction facility is typically five years, there is a requirement for new capacity to reach FID by the turn of the decade at the latest⁸.

Qatar has identified the tight margins which emerge in the mid-2020s and is likely to add an extra 20bcm/a of capacity by 2024, mostly through de-bottlenecking. Given the low production cost of Qatari gas production (estimated at under \$2/mmbtu), it is possible that new Qatari capacity could delay new production from more expensive greenfield sites in Australia, North America and East Africa that might otherwise have been expected. However, in our estimation, new capacity will come online to meet the expected growth in demand, but this new supply will be at a higher marginal cost than current supplies.

⁸ Capacity enhancement at existing assets would have shorter lead times

On the buy-side, there are a number of areas where LNG is likely to be attractive, especially South America and South Asia. An important enabler for new entrants will be the development of FSRUs and leasing current FSRUs which have significantly lowered capital costs and have shorter lead times compared to typical onshore terminals.

In summary, our expectation is that the price of LNG around the world will rise to ensure that the required investment in liquefaction takes place in order to meet growing global demand.

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2. INFRASTRUCTURE OPTIONS TO ACCESS LNG

The current leasing arrangement expires in 2024 and after this date there are a number of options that can be considered to maintain access to LNG. Having discussed a number of options with Klaipėdos nafta and stakeholders; and having reviewed current market activity, we have investigated the following five options for accessing LNG:

- purchasing a FSRU;
- continuing to lease the existing FSRU;
- building a permanent onshore terminal;
- importing small-scale LNG only; and
- using an older LNG carrier as an FSU.

We have looked into the possible capital and operating costs of each option, and the volumes and flexibility that each option could provide.

2.1 Purchase a FSRU

We have based our analysis of this option on the purchase of the existing vessel. However, should an equivalent vessel be available, this would also be consistent with this analysis.

This option provides flexible supplies of LNG into Lithuania and the capacity to supply the combined demand of all the Baltic States. The capacity of the FSRU allows the majority of LNG carriers to deliver a full load, which makes contracting for deliveries more straightforward and commercially attractive for sellers.

We do not have access to the confidential commercial arrangements between KN and Höegh LNG relating to the option to purchase the FSRU in the future. Instead we have adopted a methodology based on available public information.

We have investigated the potential cost of building a vessel such as the Independence using public information from Höegh LNG, the Oxford Institute of Energy Studies (OIES) and others, and estimate that the initial order value for the Independence was \$250-330 million⁹. By assuming potential depreciation profiles, an asset life of between 35 and 45 years, and the possibility that the current lease payments include some contribution to the capital cost of the vessel, we have estimated the purchase price in 2024 to be between €121 and €160 million.

At all stages the FSRU will have either a scrappage or a re-sale value.

We have also evaluated a sensitivity to assess the potential value of bringing forward the purchase of the vessel together with a renegotiation of the current lease payments, which is outlined in Annex B.

⁹ 'The Outlook for Floating Storage and Regasification Units', June 2017, OIES

2.2 Continue to lease the existing FSRU

The future charter costs of the existing FSRU have been provided to us by KN and these amount to between around €25 to €35 million each year depending on the length of the lease (10 year or 20 year contract periods). Further detail is provided in Section 3.2.

Our understanding is that these annual charter costs would be available to KN from 2019 and therefore if the leasing option is pursued then the existing charter costs could be reduced before 2024.

We do not envisage any additional capital costs under this option.

Retaining the existing FSRU provides the flexible supplies and capacity described above.

2.3 Build a permanent onshore terminal

The total cost of building an onshore terminal is estimated at €600million⁹. Although the necessary dredging has been carried out and there is an existing jetty, it is likely that there is not enough space onshore to construct a terminal at Klaipeda, so none of the existing infrastructure could continue to be used and a new site would need to be identified.

The operating costs of an onshore terminal are likely to be between €6 and €12 million¹⁰ per annum.

An onshore terminal offers increased capacity and flexibility, way beyond the likely demand requirements of the Baltic States alone. Given the very high costs, relative to a FSRU, and the unnecessary additional capacity we did not analyse this option in any further detail and it was disregarded in the cost-benefit analysis.

2.4 Import small-scale LNG only

Currently, large-scale LNG is reloaded onto smaller vessels at Klaipeda and stored in bullet tanks nearby for loading onto trucks for distribution. It is possible that Lithuania could use more small-scale LNG, which was not reloaded at Klaipeda but instead transported in small LNG carriers from another large-scale terminal, such as GATE in the Netherlands, or in future, Swinoujscie in Poland.

There are considerable additional costs in transporting LNG in this way. Assuming the LNG is available at the hub price local to the large-scale terminal, it would then be necessary to add the port fee, the reloading fee, the charter costs and the fuel costs of the small LNG carrier. In order to import 1.2bcm of LNG (which is approximately the volume of LNG imported to Lithuania in recent years) in this way from GATE, at least two small LNG carriers would be necessary and the additional costs would be in the region of €25 million each year. (This figure is very sensitive to the charter rate of the LNG carriers which has been volatile in recent years).

The logistics of this arrangement are also uncertain. The existing storage tanks are not likely to be large enough and the onwards distribution would need investment if small-scale LNG was to be injected to the existing gas grid or potentially transported by truck to off-grid locations.

¹⁰ \$20,000 and \$40,000 each day. 'Comparative research on LNG receiving terminals and FSRU', October 2017, Australia China Natural Gas Technology Fund

We have not carried out more detailed analysis on this option because of the limited volumes and limited flexibility it offers, as well as the ongoing costs, uncertain logistics and capital investment that is likely to be necessary.

2.5 Use an older LNG carrier as a Floating Storage Unit (FSU)

In the past few years, there have been a number of LNG projects which have been developed using an FSU as storage capacity for the imported LNG. Typically, these projects have been developed using an older LNG carrier which was considered to be no longer economic to operate in commercial LNG transportation.

The current global LNG fleet now consists of more than 400 ships and there are likely to be a number of older ships that might be available for sale and conversion to FSU service. Generally, eligible ships will be older ships with an LNG storage capacity of 125,000-140,000m³, and would need some modification before it could be put into service for an extended period

The jetty facility should be reusable and it is likely that an LNG carrier converted to an FSU could be safely, permanently moored, as the basic hull size is similar.

Total cost and logistics

At this stage, based on general observations and with no engineering studies of the feasibility, the range of potential capital expenditure for an FSU plus regasification unit would appear to be in the range €135-225 million.

Logistically there are also three main issues to consider:

- Firstly, the smaller LNG storage volume on the FSU will complicate the LNG delivery as it will require the delivery of part cargoes or the use of smaller LNG carriers than those used to deliver to the 170,000m³ FSRU. Such constraints may impact on the delivery price of the LNG.
- It will take time to establish the new facility once the existing FSRU has been removed from the jetty. This could be a few weeks to install and connect a regas barge or several months if the jetty has to be modified.
- The more complex operation of the FSU and a separate regas skid, which inevitably is a less integrated system than that currently on the FSRU, will also require the recruitment and training of a new team.

In summary, whilst it may be technically feasible to replace the existing FSRU with a facility based on the conversion of an old LNG carrier to an FSU and provide a separate regasification skid, the costs and possibly more complex operations mean that this is not an attractive option.

2.6 Summary of infrastructure options

Table 4 – Summary of infrastructure options

Option	Capex	Opex (p.a.)	Flexibility	Summary
Purchase FSRU	€121 – 160m	€10 – 15m	Can supply flexible volumes and capacity. Option to sell if demand changes	Viable option
Lease FSRU	~€ 0m	€25 – 35m	Can supply flexible volumes and capacity. Flexible leasing options	Viable option
Build onshore terminal	€ 600m	€6 – 12m	Can supply flexible volumes and capacity. No re-sale value	High capex cannot be justified
Import only ssLNG	?	~€25m	Substantially smaller annual capacity and logistics uncertain	Similar annual costs to FSU but lower volume
Use older carrier as FSU	€135 – 225m	€4m	Less capacity and operational flexibility	Costs not low enough given reduced flexibility

3. COSTS OF ACCESS TO LNG

The previous section discussed the possible options for Lithuania maintaining access to LNG and concluded that the viable options were either a purchase of the vessel or an extension to the lease. In this section these options are considered in more detail and also other costs that are included in the CBA such as those associated with the Designated Supplier are addressed.

3.1 Cost of purchasing

There are several elements that need to be considered within the costs of purchasing a FSRU.

- Initial capital cost and financing:
 - The current lease arrangement contains an option to purchase the vessel at the end of the lease. We are not party to the confidential terms and conditions for this purchase, so we have estimated a capital cost of €160m¹¹ (the upper end of our range in order to be conservative) based on our assumptions of the original cost of the vessel and the subsequent depreciation.
 - Should the contractual purchase cost be greater or lesser than this amount, the CBA should be adjusted accordingly. Similarly, should an alternative vessel of similar size and technical capability to the Independence be available at a lower cost, then this would improve the results of the CBA.
 - We have used the Spackman approach to include the cost of the initial capital outlay and subsequent financing costs within the CBA. Under the Spackman approach a firm's financing costs are taken into account by converting the firm's investment cost into annual payments (an annuity) using the firm's weighted average cost of capital. We have used a weighted cost of capital to KN of 5.43% (as provided by KN).
- Operations and maintenance costs:
 - There are operating and maintenance costs that would be incurred each year, as well as a requirement for dry-dock assessments every 10 years. The cost of these elements has been provided to us by KN.
- Residual value:
 - In the case where the FSRU is purchased, we have assumed that the vessel will have a scrap value at the end of the period of operation. We have estimated the scrappage value to be €27.5m¹² based on the characteristics of the vessel and recent (though admittedly limited) data on scrappage values for LNG tankers. This could be higher if the FSRU is still in a good workable condition, as LNG importation will still be in demand in other parts of the world.

3.2 Cost of leasing

We have considered the cost of extending the current leasing arrangements by either 10 years (to 2034) or 20 years (to 2044).

¹¹ In nominal terms, payable in 2025

¹² In nominal terms, received in 2044

The estimates of the annual leasing costs were provided to us by KN. We understand that the annual leasing costs would be available before 2024 and therefore a reduction in leasing costs before this date could lead to lower costs during this period.

Alongside the annual leasing costs, KN is also responsible for a number of annual operating and maintenance expenses which have also been included as well as a requirement for dry dock assessments every 10 years.

3.3 Designated Supplier costs

To ensure the operational integrity of a FSRU, a minimum number of cargoes each year are necessary. Under the current arrangements, LITGAS performs the role to ensure that such minimum cargoes are delivered. If the cost of such cargoes exceeds the 'market' value of such gas, then LITGAS is able to recover the shortfall from end consumers of gas. In 2018 this cost is estimated to be €25m¹³ (a premium of €6.88/MWh).

The costs currently incurred for the Designated Supplier element relate to a contract signed (and renegotiated) by LITGAS, but which may not be reflective of the premium necessary to ensure future operations.

In general, the most competitive prices for LNG can best be achieved through agreeing to large volumes, with limited flexibility for the buyer, and with a reasonable notice period between coming to market to purchase LNG and the required date of delivery.

In future, if there is sufficient commercial use of the terminal, then a Designated Supplier contract would not be necessary. Alternatively, arrangements could be altered so that only those cargoes required due to the absence of commercial cargoes would be purchased.

Based on our understanding of premiums in the LNG market, we have assumed that cargoes equivalent to the same annual volume of the LITGAS/Statoil contract¹⁴ (3.6TWh) could be delivered to Lithuania at a reduced premium of €0.85/MWh (\$0.30/mmbtu) above benchmark European LNG prices. This represents a substantial reduction in cost to the current arrangements.

It should also be noted that both the role of the Designated Supplier to the FSRU, and the subsequent arrangements for selling the gas imported by the Designated Supplier will have a considerable effect on the level of competition in the wholesale gas market in Lithuania (or any regional market). Economic theory suggests that competition should result in the lowest cost. Competition could be brought about both in the role of the Designated Supplier itself, and in the way in which gas is sold to wholesale market participants and/or end users.

3.4 Sunk costs

There are some infrastructure investment costs at Klaipeda which have already been incurred and that the NRA has agreed can be recovered, e.g. jetty and pipeline costs. These sunk costs remain whether or not Lithuania retains access to LNG and as a result,

¹³ http://www.regula.lt/SiteAssets/posedziai/2017-11-21/1_litgas_pazyma.pdf

¹⁴ <http://www.litgas.lt/en/litgas-and-statoil-have-signed-the-amended-baseload-supply-agreement/>

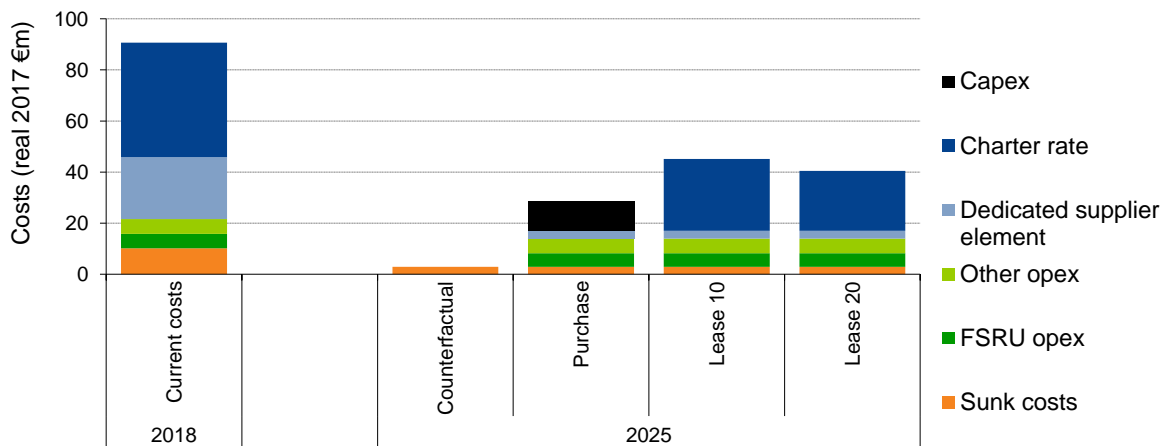
these costs can be excluded from the CBA. The costs will still need to be recovered from end-users.

3.5 Total costs

Figure 10 illustrates the annual costs under different structures. In the Counterfactual (i.e. LNG is not retained) there are some residual costs which must continue to be paid by consumers relating to infrastructure investments which have already taken place. Since these costs are sunk, they need not be considered within the forward-looking CBA.

For the scenarios which retain access to LNG, there are some costs which are common to all structures (annual Opex and the Dedicated Supplier element). Substantial differences emerge when we examine the charter rate in the lease options (20 year lease has a lower annual cost than a 10 year extension) and in particular when the annuitized capex is considered in the case of the purchase of a FSRU.

Figure 10 – Annual costs of retaining access to LNG



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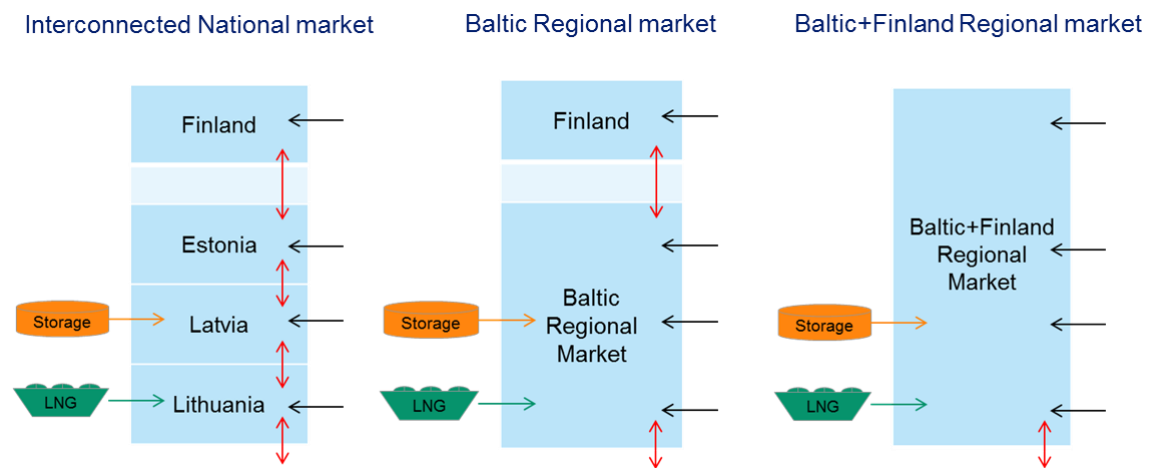
4. BENEFITS

The initial analysis has been designed to quantify the net benefit of maintaining the Klaipeda LNG import facility in Lithuania. This is focused on three main areas of analysis:

- wholesale gas prices;
- security of supply; and
- small-scale LNG.

There are a number of uncertainties in considering how the gas markets may look between 2024 and 2044, which have been modelled under three different market structures, as set out in Annex C.2 and illustrated in Figure 11, as well as with and without LNG.

Figure 11 – Three market structures

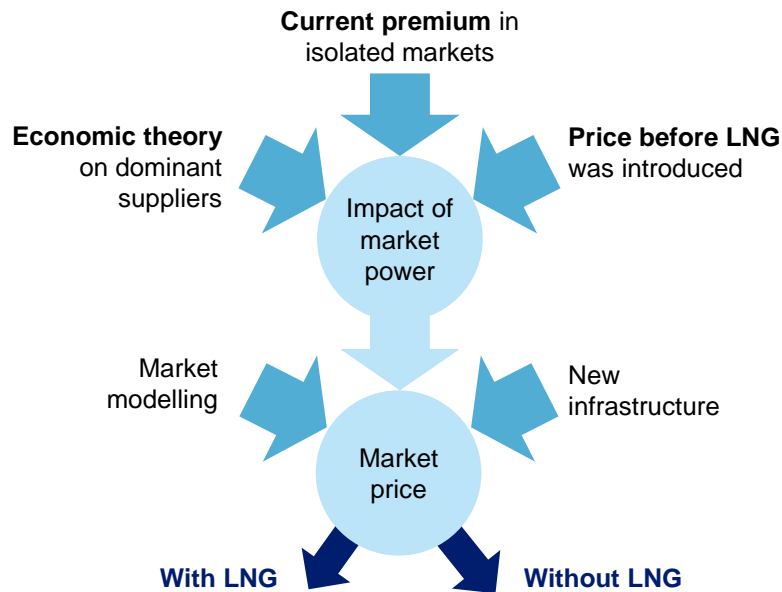


4.1 Wholesale pricing analysis approach

Our approach to wholesale gas market pricing is illustrated in Figure 12 and described below in three stages:

- calculating competitive wholesale gas market price projections under each market structure;
- quantifying the impact of market power with and without LNG; and
- calculating the wholesale gas market prices with and without LNG under each market structure taking into account the degree of market power that may be exerted.

Figure 12 – Methodology to determine market prices with and without LNG



4.1.1 Projecting competitive market price

Wholesale gas market price projections are based on Pöyry’s Q3 2017 Central Scenario assumptions which include the following:

- gas demand assumptions for the Baltic States and Finland are based on the ENTSOG Blue Transition demand projection;
- infrastructure is developed and includes:
 - Balticconnector (between Finland and Estonia);
 - upgraded capacity at the Estonia/Latvia interconnection point;
 - GIPL (between Lithuania and Poland);
 - Upgraded capacity at the Lithuania/Latvia interconnection point;
- Russian gas in the rest of Europe is re-contracted at current volumes, except to Poland, where no contracts are renewed; and
- Russian gas sold into Europe – including the Baltic region – is priced with a reducing degree of oil-indexation.

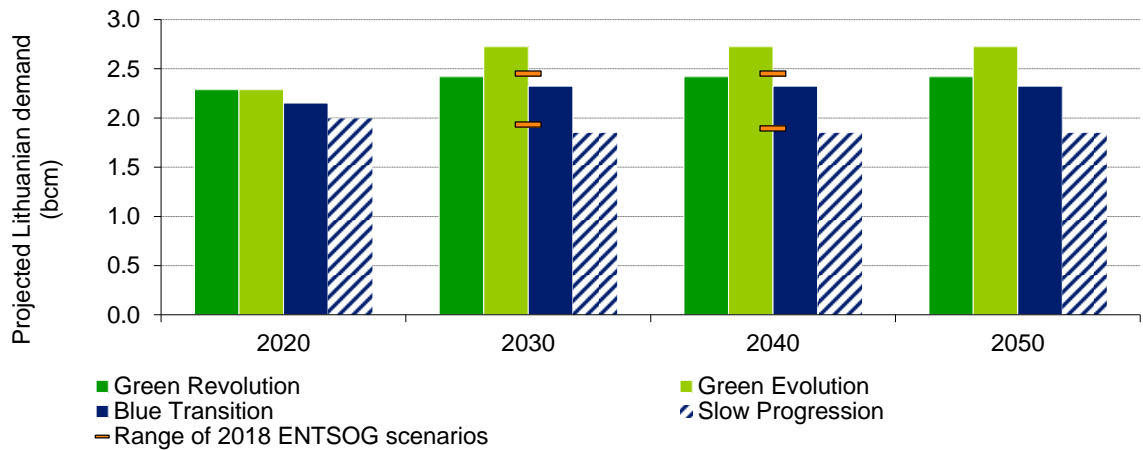
The Pegasus3 model is run based on these assumptions and including an operational LNG terminal in Lithuania. Wholesale gas market prices are projected under each of the three market structures.

Demand assumptions

Gas demand assumptions for the Baltic States and Finland are based on the ENTSOG Blue Transition demand projection. The assumptions for Lithuania are compared with projections from other ENTSOG scenarios below in Figure 13. The Blue Transition projection is central in the ENTSOG range – similar to, but slightly lower than, the Green Revolution scenario.

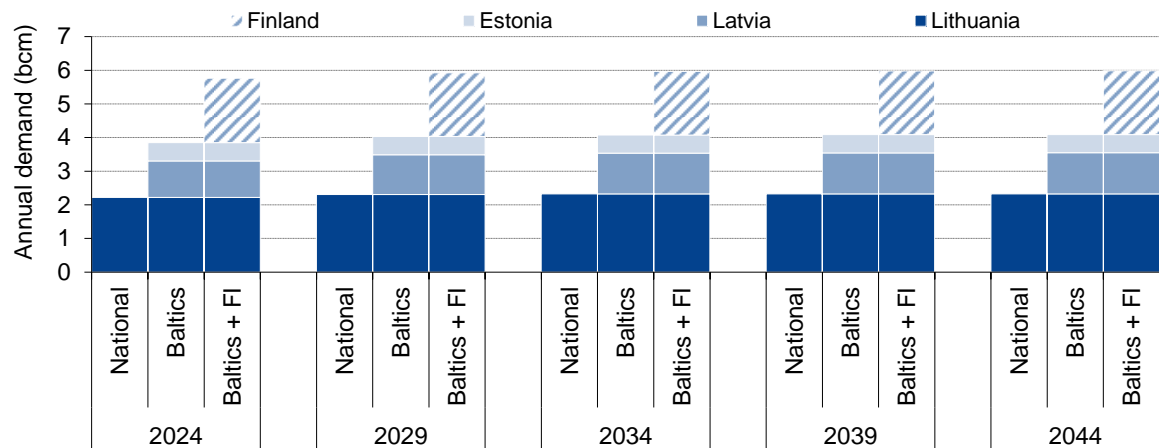
The scenario illustrates that gas demand is expected to be stable over the assessed period. Currently, demand is dominated by industrial and commercial use, and all sources for projections indicate that the demand in this sector is likely to remain at similar levels to today. The Blue Transition projection includes a small increase in the gas used in power generation by 2030, but stable thereafter. We have also carried out a sensitivity (described in Annex B.2) using the demand projection of the ENTSOG Slow Progression scenario, which is the lower bound of ENTSOG’s projections.

Figure 13 – Lithuanian demand projections



The aggregate annual demands for each market structure are shown in Figure 14, indicating that demand is also stable within the others Baltic States and Finland, and hence each of market structures considered.

Figure 14 – Aggregate annual demands under market structures



4.1.2 Quantifying the impact of market power

The impact of market power is not easily modelled as it is hard to project the degree to which a dominant supplier would mark-up its price. A number of factors will be at play due

to the range of political and economic influences that can determine the behaviour of a dominant supplier.

In the first step of our analysis we have calculated the Residual Supplier Index (RSI) for each country under each market structure.

The RSI of a market is used to determine whether a single supply source is ‘pivotal’ to that market, i.e. whether a market can or cannot be supplied without supply from that specific source. A supply source is considered to be ‘pivotal’ to a market if $RSI < 100\%$.

The RSI analysis has been conducted in line with assumptions adopted by ACER¹⁵ for similar analysis of gas markets, as follows:

- maximum annual average pipeline capacity utilisation is assumed to be no greater than 85%;
- maximum annual average LNG import capacity utilisation is assumed to be no greater than 75%; and
- annual gas supplies excludes storage capacity.

Figure 15 shows the RSI calculation for Lithuania and Latvia following the introduction of LNG in 2014. Russia ceased to be a pivotal supplier to Lithuania but the interconnection to Latvia was not of sufficient capacity to supply 100% of Latvian demand, so Russia remained a pivotal supplier there.

Figure 15 – RSI calculation for 2014

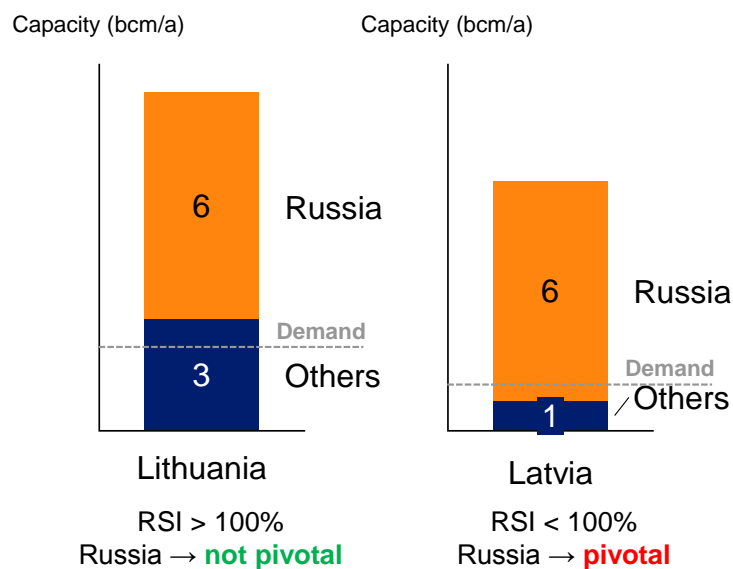
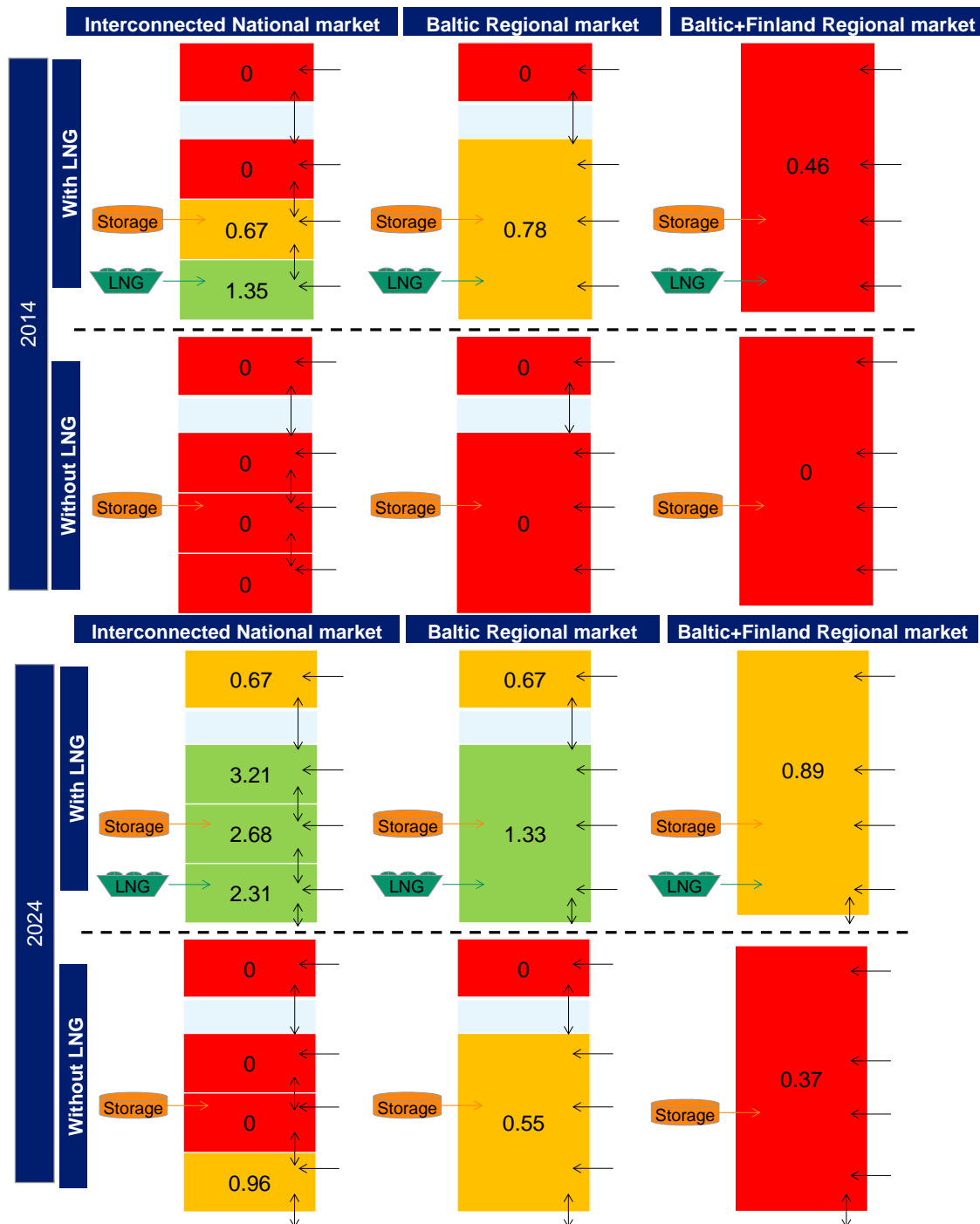


Figure 16 shows the RSI in 2014 and 2024 respectively both with and without LNG. While ACER’s target RSI for a gas market is at least 1.1, empirical data suggests 1.2 is the level at which no market power can be exerted; and where this is the case the market is coloured green. If the RSI rounds to at least 0.6 then the market is coloured amber.

¹⁵ <http://www.acer.europa.eu/Events/Presentation-of-ACER-Gas-Target-Model-/Documents/European%20Gas%20Target%20Model%20Review%20and%20Update.pdf>

It is worth noting that between 2014 and 2024 the introduction of increased capacity between Lithuania and Latvia has increased the RSI of both Latvia and Estonia, under the Interconnected National Markets structure. Also, in 2024 when GIPL is present, Lithuania is nearly at an RSI of 1.0, even without LNG.

Figure 16 – RSI in 2014 and 2024 with and without LNG under each market structure

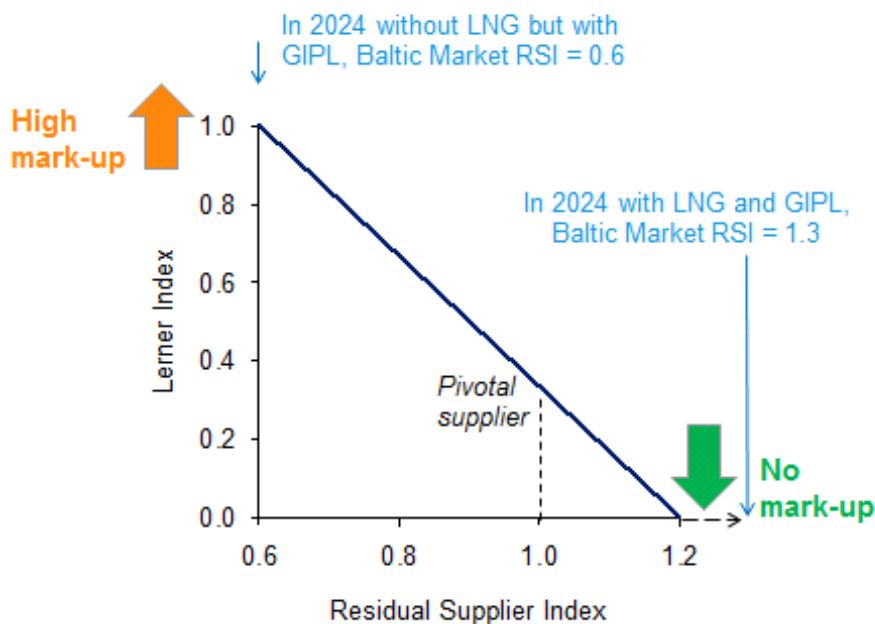


Note: Capacities in 2024 include the expected developments at GIPL and higher Lithuania-Latvia interconnection

There is a relationship between the RSI of a market and the price mark-up which a dominant supplier is likely to add, although there is very little empirical data available to illustrate this in gas markets.

Figure 17 shows a relationship derived from observing the Californian electricity market¹⁶, which shows that at an RSI of 1.2 there should be no mark-up from a dominant supplier; whereas at an RSI of 0.6 there is a significant mark-up.

Figure 17 – RSI and Lerner Index



Source: CAISO, FERC market monitoring workshop

It is difficult to determine from empirical data the premium that gas suppliers are able to extract in situations where there is market power since prices are influenced by many factors, including oil price and contract structure. We have looked at the price of gas in Lithuania before and after the introduction of LNG (see section 1) and observed a significant drop in prices, of between 20% and 30%. However, although the introduction of LNG played a role, this reduction was also influenced by falling oil prices and other factors, and cannot be solely attributed to reduced market power – although that was undoubtedly a factor.

More recently, the 2016 ACER market report¹⁷ included import prices across European states. The six markets reporting the highest import prices are notable in that they are dominated by Russian supplies and/or are isolated and have restricted import capacity. These member states are Croatia, Estonia, Sweden, Poland, Latvia and Finland. The average reported import price from these states was 18.5€/MWh, 11% higher than the import price reported in Lithuania (16.7€/MWh). Interestingly, Croatia, which reported the

¹⁶ 'Predicting market power using the residual supplier index', California ISO, December 2002

¹⁷ 'Annual Report on the Results of Monitoring the Internal Electricity and Gas Markets in 2016', October 2017, ACER

joint highest import price (19.5€/MWh), is currently making the final investment decision on a new FSRU.

When choosing the potential price premium resulting from market dominance, the likely range appears to be around 11% up to over 20% (if prices returned to similar levels seen before Lithuania introduced LNG). We chose the bottom of the range, given the likely future moderating influence of the European Commission on Russian pricing strategy.

Therefore, in our analysis 11% represented the high end of the potential mark-up in price where there is a high degree of market dominance (i.e. when RSI is 0.6 and Lerner Index is 1.0). This was pro-rated down to a zero mark-up on our competitively modelled market prices when the RSI was 1.2, and the Lerner Index was 0.

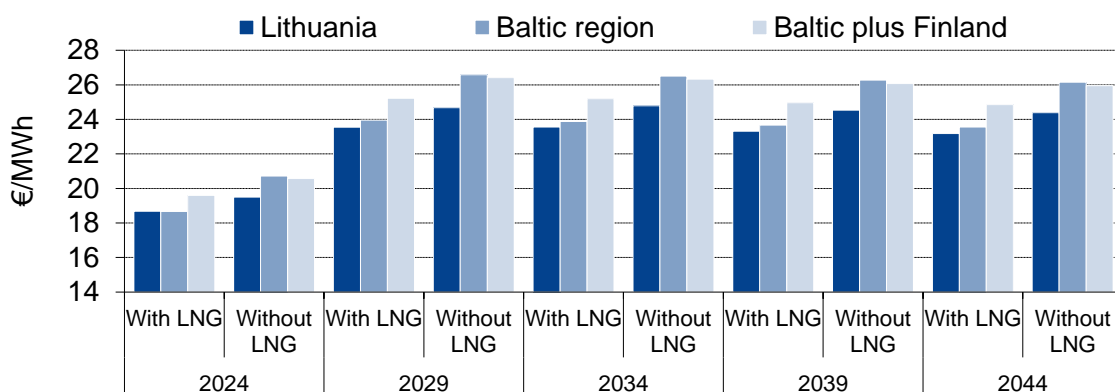
As a sense check, the benefits which arise from wholesale gas prices alone are compared to the current leasing cost of the FSRU. In the event that the premium charged by a dominant supplier exceeds the cost of leasing a FSRU, then Lithuania would be incentivised to re-contract for a FSRU and so such a premium would be unsustainable on a long-term basis. Our sense-check showed that an 11% premium is consistent with this logic.

4.1.3 Wholesale gas market prices with and without LNG

Using the methodology outlined above and applying the impact of market power ‘mark-up’ the range of wholesale gas price projections are calculated and shown in Figure 18.

The dark blue bar shows the market price in Lithuania under the Interconnected National Markets structure. The market price rises when Lithuania becomes part of a regional market in most cases. This is even the case without LNG because in these scenarios GIPL offers Lithuania a price benefit when it has some separation from the region.

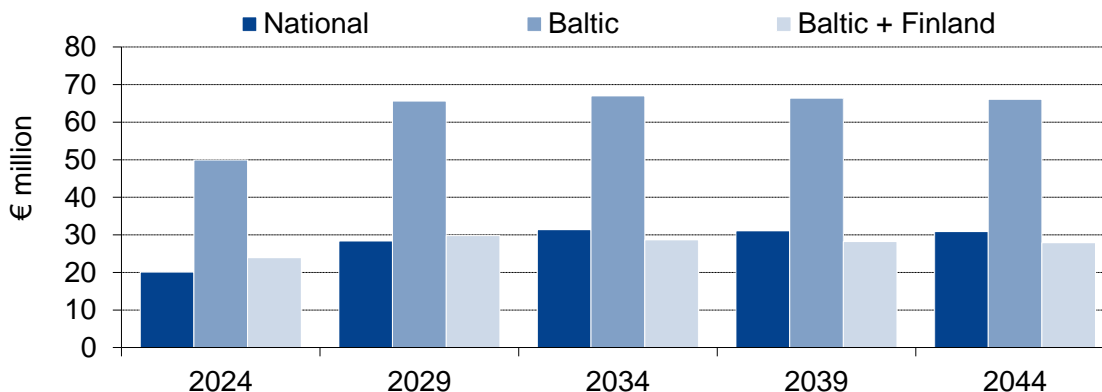
Figure 18 – Wholesale gas market prices with and without LNG



Taking these price differentials and multiplying by the demand from the Lithuanian market alone, provides the benefit to the Lithuanian market, shown in Figure 19. The benefits are greatest under the Baltic market structure, as the RSI moves from 0.6 to 1.3 for the Baltic market when LNG is available (see Figure 16) and this totally removes the impact of market power from the market price. Whilst the market price is lower for Lithuania under the Interconnected National Markets structure, the benefit is greatest under the Regional market structure due to the largest differential between the market prices in this case.

The benefits to Lithuania due to the reduction of wholesale gas market price, from having LNG as a source of supply, is between €20 and €60 million a year.

Figure 19 – Benefits resulting from lower wholesale gas price in Lithuania



4.2 Security of supply

To understand the additional benefit of the FSRU for security of supply to Lithuania and the Baltic region, the impact of three interruptions to gas supply have been assessed; all outages are in January under cold weather conditions. These cases have been chosen to reflect the requirements for security of supply under the relevant regulations:

- An interruption of all Russian supplies into the region:
 - in line with the requirement under the regulation to consider ‘disruption of supplies from third-country suppliers, as well as, where appropriate, geopolitical risks’¹⁸.
- An interruption to the Inčukalns storage facility:
 - at 20-30mcm peak withdrawal capacity Inčukalns represents the single largest gas infrastructure in the proposed regional market¹⁹.
- An interruption of Russian supplies via Belarus only:
 - aligned with a scenario considered by ENTSG in its October 2017 study²⁰. Within this scenario, supplies of Russian gas via Belarus are interrupted stopping some flows into Poland (pushing up prices via GIPL) and all Russian gas into Lithuania.

The Pegasus3 gas market model was used to assess the increased cost of gas during each interruption, and each scenario was run with and without LNG to assess the benefit of LNG in reducing price volatility at times of interruption.

¹⁸ Regulation 2017/1938, *ibid*, Article 7.4.c.ii

¹⁹ Note that the facility cannot maintain the peak rate of 30mcm/d as the inventory drops.

²⁰

https://www.entsog.eu/public/uploads/files/publications/sos/ENTSG%20Union%20wide%20SoS%20simulation%20report_INV0262-171121.pdf

The benefits of LNG, which vary under each market structure and under each security of supply scenario, are summarised below.

An interruption to all Russian supplies into the region

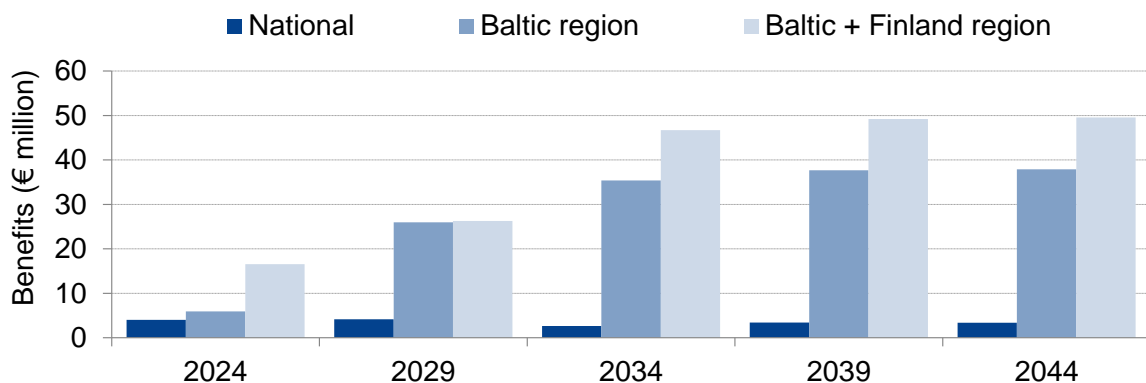
The benefits of having LNG during an interruption of Russian gas, under each market structure, are shown in Figure 20. The benefit is highest under the Baltic plus Finland Regional Market at almost €50million for the month of interruption from 2039.

The impact of an interruption to Russian gas has the least impact upon Lithuania as a national market, because it still has a source of gas supply via GIPL which is sufficient to meet demand with or without LNG.

The larger Baltic Regional Market faces much higher prices under an interruption of Russian gas, which are reduced when LNG is available. Similarly the Baltic plus Finnish Regional Market experiences even higher prices which are mitigated by LNG, leading to the highest benefit.

The global market tightens over time, increasing the impact of an interruption and hence the security of supply benefit of LNG increases over time.

Figure 20 – LNG benefits to Lithuania due to an interruption of Russian supplies

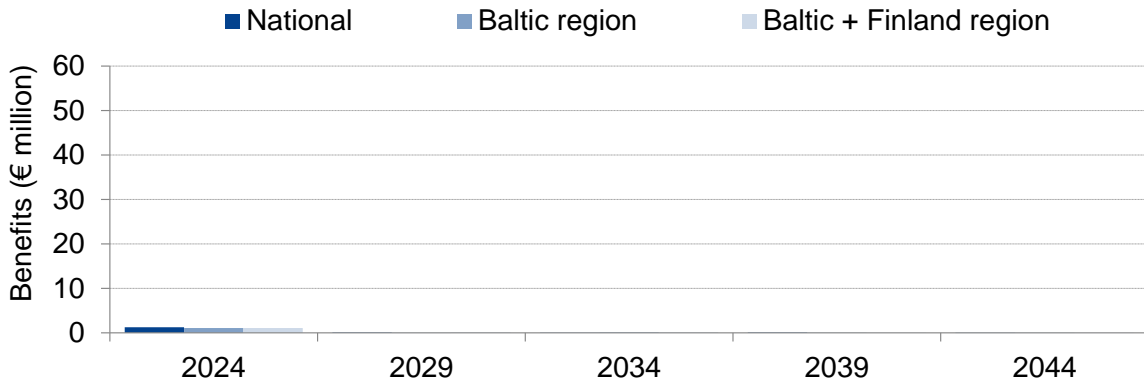


N.B. Scale fixed to allow comparison with Figure 21 and Figure 22

An interruption to the Inčukalns storage facility

During an interruption of the Inčukalns storage facility Russian gas is more than able to meet the supply shortfall so the benefits of having LNG are negligible, as shown in Figure 21. There is a small reduction in gas price during the interruption when LNG is available in 2024, which results in a very small benefit.

Figure 21 – LNG benefits to Lithuania due to an interruption of Inčukalns



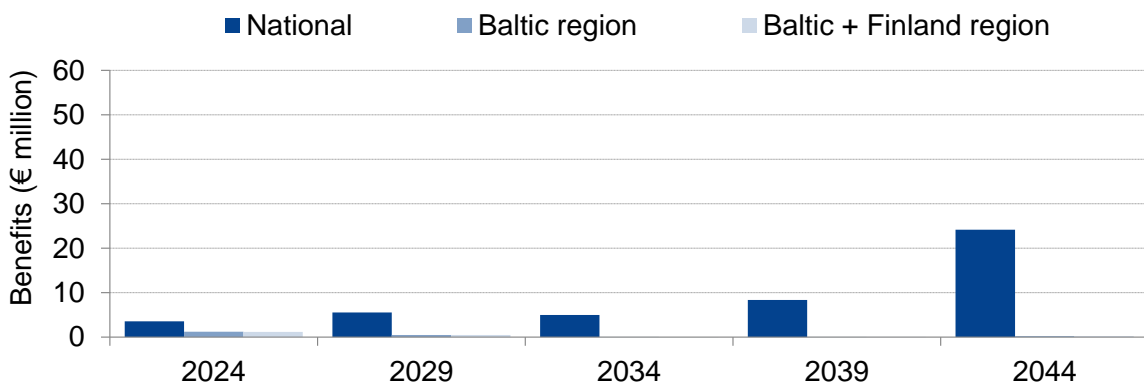
N.B. Scale fixed to allow comparison with Figure 20 and Figure 22

An interruption of Russian supplies via Belarus

The benefits of having LNG during an interruption of Russian gas via Belarus, under each market structure, are shown in Figure 22. Interrupting supply via Belarus leaves the Polish market highly stressed for supplies and GIPL capacity is fully utilised exporting from Lithuania to Poland. When Klaipeda is not present there is insufficient gas to export to Poland and by 2044 Poland is forced to shed demand for certain periods which pushes the price up even higher.

Of the gas market structures modelled, it is only when Lithuania is a separate national gas that the impact of the interruption is felt. The mitigation of the high prices during the interruption due to the availability of LNG and the resulting benefits to Lithuania, reach over €20 million by 2044.

Figure 22 – LNG benefits to Lithuania due to an interruption of Russian gas via Belarus



N.B. Scale fixed to allow comparison with Figure 20 and Figure 21

Estimating the probability of each event occurring is not a straightforward task, since there is little or no empirical evidence to use. Instead, we have first used a simple qualitative approach of identifying that each case examined would occur only in the event of political disruption or major technical failure. As a result, we categorise the events as very low probability (even though the impact if the event occurred would be significant).

Accordingly, we then allocate a 0.33% of each event occurring, such that there is a combined probability of 1% taken into account within the CBA which we believe to be a conservative approach.

Table 5 shows the impact of altering the probability weighting on such events occurring.

Table 5 – LNG benefits to Lithuania of access to LNG from all security of supply scenarios (€m)

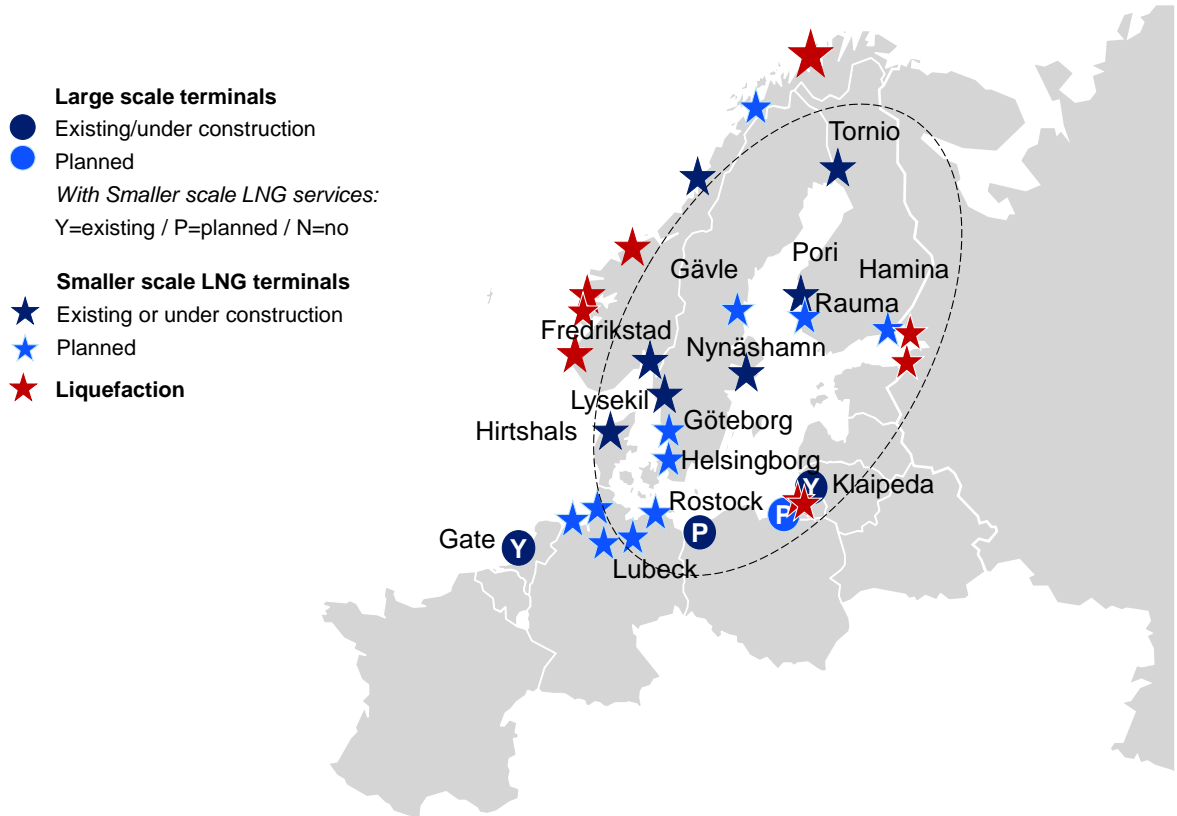
Probability (%)	Market	2024	2029	2034	2039	2044
100%²¹	National	8.96	9.95	7.76	12.05	27.93
	Baltic region	8.32	26.89	36.09	38.38	38.75
	Baltic + Finland	19.09	27.28	47.56	50.06	50.58
5%	National	0.45	0.50	0.39	0.60	1.40
	Baltic region	0.42	1.34	1.80	1.92	1.94
	Baltic + Finland	0.95	1.36	2.38	2.50	2.53
1%	National	0.09	0.10	0.08	0.12	0.28
	Baltic region	0.08	0.27	0.36	0.38	0.39
	Baltic + Finland	0.19	0.27	0.48	0.50	0.51
0.33%	National	0.03	0.03	0.03	0.04	0.09
	Baltic region	0.03	0.09	0.12	0.13	0.13
	Baltic + Finland	0.06	0.09	0.16	0.17	0.17

²¹ 100% reflects the benefit from LNG if all security of supply events occur

4.3 Small-scale LNG approach

The potential benefit of a reloading service for small-scale LNG in Lithuania relates to the capacity of ssLNG ports existing and planned around the Baltic region and assumptions for minimum throughput. Figure 23 shows the existing and planned ssLNG terminals within range for reloading in Lithuania and Table 6 lists the existing and planned ssLNG terminals and their capacity.

Figure 23 – ssLNG terminals within range for reloading in Lithuania



Although Lithuania is very well positioned to reload the LNG that will be taken to these terminals, there is competition in the ssLNG market from liquefaction in Norway, the planned reloading service at Swinoujscie and possibly new liquefaction in Russia. We have thus assumed Norway continues to supply ssLNG at its current rate and another 50% of the reloading market is lost to other competition.

We have also assumed that each ssLNG terminal has ten turnovers per year to maintain a minimum temperature, and that 50% of the planned capacity goes ahead by 2024 in our high case.

Table 6 – ssLNG port capacity in range from Lithuania

ssLNG Port	Start date	Storage capacity
Tornio	Commercial operation starting mid-2018	50,000 m ³
Pori	Existing (2016)	30,000 m ³
Lysekil	Existing (2014)	30,000 m ³
Nynashamn	Existing (2011)	20,000 m ³
Fredrikstad	Existing (2011)	6,400 m ³
Hirtshals	Existing (2015)	500 m ³
EXISTING CAPACITY	Combined capacity of 136,900 m³ LNG which requires approximately 10 turnovers per year to maintain a minimum temperature, which equates to 0.62 million tonnes of LNG, or 0.8bcm of gas	
Rauma	Planning stage	10,000 m ³
Hamina	2020	30,000 m ³
Gavle	Two competing projects (Skangass - proprietary, Swedegas – open access), both in planning stage. Only room for one. Timeline unclear.	
Goteborg	Swedegas project, planned in two phases. Final capacity likely to be 30,000 m ³	
Helsingborg	Planning phase	15,000 m ³
Lubeck	Project in early phase	Currently unclear
Rostock	Project – feasibility study performed by Pöyry in 2016	Currently unclear
PLANNED CAPACITY	By 2024 we assume a further 75,000 m³ LNG capacity goes ahead (approx. 50% of planned), again requiring approximately 10 turnovers per year, which equates to 0.34 million tonnes of LNG, or 0.4bcm of gas	

Our Low case for ssLNG reloading is derived as follows:

- assume market size of 0.62 mtpa, 0.3 of which is supplied by Norway, leaving 0.32 mtpa LNG or 0.44bcm (standard);
- assume a Lithuanian terminal wins 50% of remaining market;
- 0.22bcm/yr throughput of ssLNG in Lithuania; and
- €2.7m turnover per year (at the current tariff at Klaipeda of 1.14€/MWh).

Our High case for ssLNG reloading in Lithuania is derived as follows:

- assume market of 0.96 mtpa, 0.3 of which is supplied by Norway, leaving 0.66mtpa LNG or 0.90bcm (standard);
- assume Lithuania wins 50% of remaining market;
- 0.45bcm/yr throughput ssLNG in Lithuania; and
- €5.5m turnover per year (at 1.14€/MWh)

The resulting benefit to Lithuania of the reloading ssLNG market is in the range of €2.7 to €5.5 million a year.

It is important to note that the bunkering market (the fuelling of ships with LNG) is projected to grow considerably and this would offer a further upside for the loading of bunkering vessels. For this reason, we use the higher value of €5.5m p.a. within the CBA.

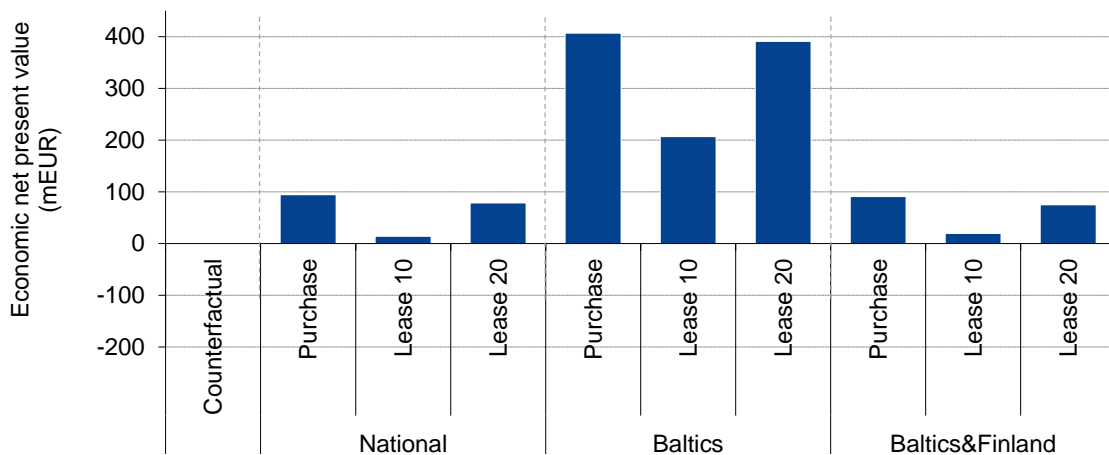
5. RESULTS OF THE CBA

The CBA methodology is described in Annex C.1. It is based on industry best practice and the evaluation is consistent with the European Commission’s guide to cost-benefit analysis for investment projects²².

5.1 Are Lithuania’s best interests served by having an LNG terminal post 2024?

The results of the main scenarios, as illustrated in Figure 24, show that in all cases evaluated there is a net economic benefit for Lithuania from retaining access to LNG after 2024, when compared with the counterfactual case in which there is no LNG.

Figure 24 – Economic net present value for Lithuania



5.2 If so, what is the optimal economic solution to access the global LNG market?

Our analysis shows that the greatest net economic benefit is achieved in all market structures when a FSRU is purchased. The net economic benefit of purchasing is closely followed by leasing a vessel for a further 20 year period.

Table 7 – Economic net present value for Lithuania (€m)

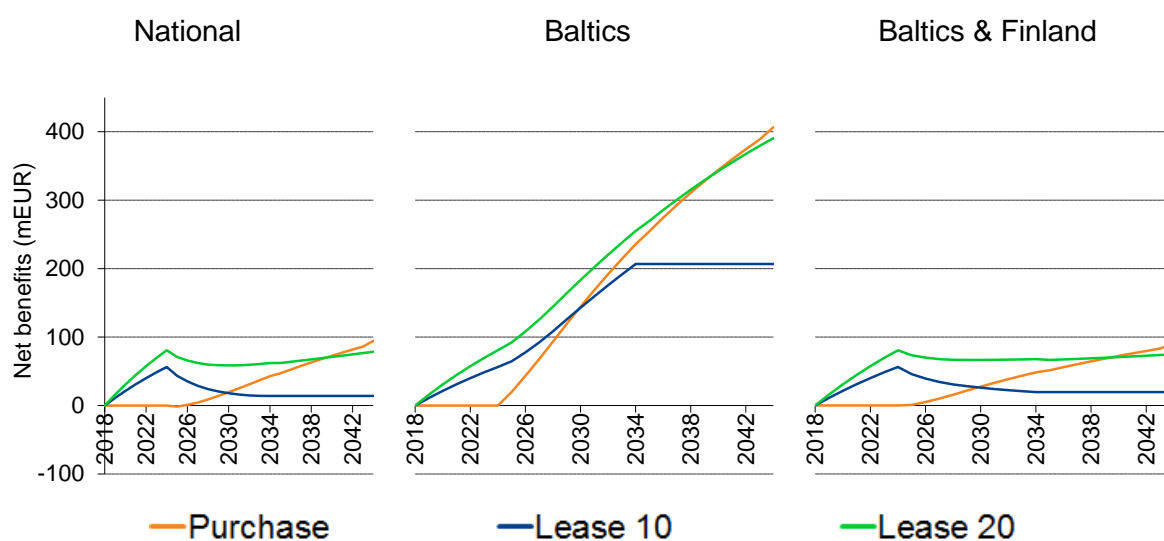
Option	National markets	Baltic market	Baltics & Finland
Purchase	94.4	406.5	90.8
Lease 10	14.0	206.8	19.6
Lease 20	78.5	390.6	74.9

²² Guide to Cost-Benefit Analysis of Investment Projects, Regional and Urban Policy, December 2014

When purchasing a FSRU, there is no net benefit or cost prior to 2025. The benefits accrue after this period, as shown in Figure 25. From the plot of the cumulative net present value, the leasing options produce benefits sooner, and are only bettered by the purchase option late in the period.

Through negotiating a reduction in the lease payments prior to the expiry of the current agreement in 2024, there is a substantial benefit in the early years which has a positive impact on the economic NPV in the cases where either extending the lease for 10 or 20 years are considered. The 20 year extension assumes lower annual costs than the 10 year extension, so results in greater savings in the early years and further net benefits in the long-term.

Figure 25 – Cumulative economic net present value



Variations due to market structure

The results show marked differences when we consider whether Lithuania retains a national market, or operates within a regional Baltic market, or part of a wider regional market including Finland.

In the case of the national markets, once GIPL is built, there is an RSI of 0.96 even without an LNG terminal, so adding LNG only tempers a small amount of remaining market power of Gazprom. The net economic value is therefore positive, but smaller than in the case of the Baltic regional market.

In the case of the Baltic regional market, Gazprom would retain a significant amount of market power in the absence of LNG. Once LNG is added, the RSI is comfortably above 1, so an LNG terminal brings a large net economic value.

Adding Finnish demand into a wider regional market means that an LNG terminal is not sufficient to produce an RSI above one; so though it produces some reduction in wholesale prices, the benefit is not as large as in the smaller regional market.

The benefits to Latvia and Estonia are described in more detail in Annex D.

5.3 Sensitivities

We have undertaken a small number of sensitivities, described in Annex B, to assess how the results would be affected by changes to key assumptions

5.3.1 *GIPL not developed*

If GIPL is not built, LNG becomes much more critical to Lithuania as a national market. However, when the gas market size increases to include the Baltics and Finland the capacity available through LNG alone is not sufficient to remove Russia's market power, so there is no reduction in overall market price and any benefits are significantly reduced.

5.3.2 *Lower demand*

If gas demand follows the ENTSOG Slow Progression scenario, the lower demand has a marked change in the overall results in the case of the Interconnected National Markets structure. In this case all options have a negative net economic benefit for Lithuania since any market power issues can be mitigated through the presence of GIPL. The results for the regional Baltic market and the regional Baltic plus Finland market are closer to the previous results and continue to show net economic benefits for Lithuania.

5.3.3 *Purchase of FSRU together with renegotiated lease*

In the case that the payments under the existing lease are also renegotiated in 2019 in conjunction with a decision at that date to purchase the FSRU Independence at the end of 2024 there is a net economic benefit to acting early if the current payments can be renegotiated as envisaged by KN.

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6. QUALITATIVE FACTORS

Alongside the benefits which we have quantified, LNG will also bring a range of benefits and costs which are qualitative in nature and which cannot be easily and objectively quantified. These are outlined at a high-level in the following paragraphs and were confirmed through interviews with a number of stakeholders. A summary of the stakeholder interviews can be found in Annex E

6.1 Qualitative benefits

6.1.1 *Facilitating a functioning wholesale gas market*

The EU Gas Target Model sets out a vision for a series of interconnected wholesale markets comprising entry-exit zones with liquid virtual trading points. Gas markets function best where there are multiple buyers and sellers that are able to transact at a liquid trading point for both short and long-term gas.

The benefits of competitive, well-functioning gas markets include:

- efficient wholesale gas prices linked to supply/demand fundamentals rather than to oil-indexed long-term contracts;
- improved diversity and security of supply as alternative supply sources are developed and new entrants are encouraged to the market; and
- development of competition in the end user market which will encourage increased end user choice, a higher quality of service, better consumer protection and access to innovative products that are tailored to specific end user needs.

A market where there is a single source of gas is unlikely to be a functioning wholesale gas market as the single seller of gas will be able to exert a degree of market power and frustrate gas-on-gas competition. The more diverse the set of supply sources to a market, the greater the potential for competitive markets to develop. Although, diversity in supply does not guarantee competition, it is difficult to see how it could be established if there is a single supply source.

The supply of LNG into Lithuania adds an important source of gas as it provides access to the competitive global LNG market. This is an important point. Whilst a further source of gas supply will be available once GIPL is in place, it does not automatically follow that this link will provide access to a competitive market. To date, the gas market in Poland cannot be seen to be a well-functioning market²³ and although there are some encouraging signs, there is no guarantee that it will achieve this in a short timescale. Furthermore, the capacity of the GIPL is not sufficiently large to have a significant impact on the Baltic region. GIPL can therefore be seen as complementary to LNG rather than as a replacement for it.

LNG is therefore an essential factor for Lithuania to secure access to a diverse set of competitive supply sources.

²³ For example, as measured against the metrics proposed by ACER of meeting participants' needs (order book volume, bid-offer spreads, number of trades, etc.) and market health (HHI, market concentration of trading activities, etc.)

6.1.2 *Competition in the end user market*

Access to a diverse set of gas sources is a building block for achieving a functioning gas market, but will not guarantee that it will be achieved or that end users will have access to it. It is an enabler that can help to facilitate competition in the end user market. Without a good level of competition in the end user market it is possible that wholesale gas market benefits are not passed on and remain with the gas shippers and traders. This is not the aim of competitive gas markets.

In order for competition to become established other measures are likely to be necessary and require some regulatory or legislative intervention. Even in markets that are viewed as competitive, like the UK, there are numerous issues that emerge and continue to require strong regulation and sometimes government intervention.

New entrants should be encouraged into the market to challenge the incumbents and to bring new and innovative products and services. In order to encourage this, the markets should be designed so that no advantage is given to incumbents over the new entrants. In some markets price regulation on the incumbents has been used to encourage new entrants to compete.

Access to competitive wholesale gas and transparent pricing is, however, essential in order to encourage new entrants.

6.1.3 *Greater control for Lithuania*

By continuing to have access to LNG, Lithuania will have a greater degree of control over the evolution of its gas market and by extension it's economy. This report has presented quantitative analysis to support the retention of the FSRU beyond 2024 as this will deliver benefits by mitigating the risk that Gazprom could exert market power and increase gas prices. In effect, LNG forces Gazprom to act in a competitive pricing manner if it wants to retain market share in Lithuania (and the Baltic region).

However, it should be considered whether this competitive pressure could be brought to bear on Gazprom from an alternative such as EU regulatory pressure or other alternative supply sources.

It may be argued that Gazprom's pricing strategy has changed and has moved away from strict oil-indexation. The anti-trust case proposals and the offer to peg gas prices to hub indices would confirm such a view. However, the anti-trust measures are only set to be in force for a period of 8 years and longer term it is difficult to have any certainty over the future pricing strategy of Gazprom. Given the period of the outlook of this report, it is also not certain that the influence of the European Commission with Gazprom will remain as it is today. It may improve, but it may also deteriorate.

Alternative gas supply sources may include gas from Poland via GIPL, but could also include LNG delivered to another location in the Baltic region. However, to rely on either of these would require either certainty that the Polish market will be a reliable source of competitively priced gas or confidence that an alternative LNG supply facility would be constructed to serve the Baltic region.

Relying either on continued EC influence over Gazprom or an alternative supply source to deliver competitive market pricing would require confidence in actors that are outside Lithuania. This ceding of control may reduce the confidence in the gas market to deliver competitive pricing in the future and could potentially have political costs.

6.1.4 *Benefit in early decision making*

In this report we have set out the benefits of maintaining access to LNG. It is likely that greater benefits can be delivered if action is taken to secure the future of the FSRU earlier than 2024. We have quantified the potential benefits of taking an early decision in Annex B.3, but alongside the cost saving, there are further benefits which have not been quantified.

By reducing the costs sooner the burden on the Lithuanian end user can be reduced and gas purchase costs can be reduced having further beneficial effects that may include:

- less money being spent on energy costs means it can be spent elsewhere in the economy with benefits being seen in other sectors;
- industrial users will also face lower costs and will improve competitiveness relative to international companies potentially leading to greater export opportunities and lower imports thus improving the balance of trade position; and
- gas will be relatively more competitive with alternative fuels and this could prevent some permanent demand destruction and avoid higher gas transportation costs for remaining end users.

6.1.5 *Benefit for the wider Lithuanian economy*

Maintaining access to international gas markets will ensure that Lithuania avoids a competitive disadvantage when compared with other EU countries. This will protect the future of existing jobs and industrial activities. As mentioned above, industrial users will face lower costs and will improve competitiveness relative to international companies potentially leading to greater export opportunities and lower imports thus improving the balance of trade position.

Through increased competitiveness, Lithuania should also benefit from economic growth in industries which rely either specifically on natural gas as a fuel, or those which rely more generally on a complete source of energy.

Alongside the direct employment of a small number of people at Klaipeda, there will also be indirect and induced jobs that will result from retaining a FSRU (for example those involved in maintenance, and providing services like accountancy, legal advice etc.).

6.2 **Qualitative costs**

In a similar manner, there are likely to be indirect costs which have not been quantified. For example:

- We have not considered the cost of additional regulation and monitoring of KN by the NCC.
- There may be wider societal costs, for example crowding out renewable investment or the impact on Lithuanian oil refining businesses through the development of small-scale LNG.
- In the cases where LNG access is not retained, we have not estimated decommissioning costs. Since this would increase the cost of the counterfactual and all the options which retain LNG would improve in comparison.

6.3 Risks

It is clear that the decision either to retain access to LNG after 2024 or not is not risk free. There are a number of risks which our analysis has highlighted.

- The size of the benefit to Lithuania of retaining access to LNG depends heavily on whether Lithuania has a national gas market, or is part of the Baltic market, or the Baltic market including Finland. The other markets also benefit from having the LNG.
- Gas demand may vary from the projections which we have used. We have evaluated the lower demand from the Slow Progression scenario (see Section 5.3.2) as a sensitivity which shows that in certain circumstances, there is a net cost to retaining access to LNG (see Annex B.2). Gas demand may be lower than projected due to a wide range of reasons (economic recession, increased competitiveness of renewable sources including biomass, increased decarbonisation ambitions of the EU). Demand is likely to remain a particular risk to Lithuania due to the fact that Achema represents a large percentage of demand, and so the situation would vary drastically if Achema's demand changes.
- Our results show that the net benefit of purchasing a FSRU only exceeds a revised lease late in the lifetime of the project – and clearly the further into the future we look, the more uncertain the outcomes become. This risk can be mitigated to some extent through the increased control that purchasing a FSRU brings, as the terminal will retain a residual value in the event that expected market conditions do not materialise.
- If a FSRU is purchased, then there will be asset performance risks which currently reside with the present owner.

6.4 Potential for unintended consequences

Retaining access to LNG could produce consequences which were not envisaged or intended by policy makers. By their very nature, unintended consequences are difficult to anticipate, but some unintended consequences can be imagined.

For example, retention of LNG and the socialisation of costs may make gas uncompetitive when compared with alternative fuels, reducing demand for natural gas.

If Lithuania joins the Baltic Regional Market but the cost of the terminal remains borne by the Lithuanian gas user, then Lithuanian users will find themselves at a competitive disadvantage to the gas users in the other nations in the market.

If state aid is provided to either KN or other market actors (e.g. the Designated Supplier), there could be distortive effects on competition in Lithuania, or the wider region, depending on how the support is provided. The decision to retain LNG might crowd out otherwise viable commercial enterprises.

7. CONCLUSIONS

From this study we are able to draw a number of conclusions.

Lithuania should retain access to LNG after 2024 since there is a net economic benefit

Without LNG, there is a real risk that there will be insufficient direct pressure from competing sources of supply to ensure that wholesale gas prices in Lithuania are in line with those at liquid wholesale hubs in continental Europe.

Analysis shows that the largest benefit comes from tempering the premium which could be charged by a supplier in a dominant position. The dominance of the supplier depends greatly on the market structure which is adopted in the future, but in the cases where Lithuania joins the Baltic regional market, having a credible alternative source of physical supply is a very valuable asset. If Lithuania retains a national market, the LNG still provides a net economic benefit, though smaller than in the case of the Baltic regional market.

This is because by 2024 it is expected that GIPL will be in operation, and this will provide a link to another alternative source of gas. However, the gas market in Poland does not yet meet the ACER metrics used to assess a 'functioning' wholesale gas market, so it may be the case that GIPL alone cannot ensure prices in Lithuania are reflective of those set at liquid wholesale hubs served by a variety of physical supply sources.

Our engagement with stakeholders confirmed that the existing LNG terminal was viewed as a positive development by the majority of those consulted.

The optimal value is achieved by purchasing a FSRU

Regardless of which market structure develops in the future, purchasing a FSRU produces the largest net economic benefit.

The alternatives of leasing for a further 10 years or a further 20 years were examined, but in each case the purchase option results in a higher net benefit over a 20-year period. Leasing for a further 10 years misses out on benefits which arise after 2034, which are captured by leasing for 20 years or through the purchase option.

Although the purchase option produces the highest net economic benefit, the 20-year leasing option is close behind. Renegotiating the lease of the current FSRU provides an opportunity to reduce the leasing costs prior to 2024, and this benefit makes a difference to the overall net economic benefit of the leasing options.

Purchasing a FSRU brings risks and opportunities

Purchasing a FSRU brings some risks which are not present in the leasing structure, for example asset performance risk. In addition, the purchase is clearly a long-term commitment, and this helps to deliver the benefits that have been calculated. However, there are risks that the gas market will develop in such a way that is not currently envisaged; the low demand sensitivity we have performed shows that there are cases where the purchase of a FSRU would result in a net economic cost.

A particular risk arises from the net economic benefit only exceeding that of the 20 year lease option at the end of the time horizon considered, and in general, the further in time from today the benefits arise, the more uncertain they become. However, in our view, the purchase of the FSRU provides Lithuania with the most flexibility to react to unexpected circumstances (for example falling gas demand) since the FSRU can be sold if required, whereas a long-term lease is a less flexible solution. The purchase option also provides

an opportunity to realise a scrappage value at the end of the project, or to operate the FSRU for a longer period or to sell to another country if it is in a suitable condition.

Our analysis shows that the purchase or lease of a smaller vessel is unlikely to result in substantial savings in cost, and would be a logistically inferior solution to the purchase of a 170,000m³ vessel, due to the limitation on tankers that can supply LNG.

Retention of LNG also brings a range of qualitative benefits

Apart from the quantitative benefits, there are also a number of qualitative benefits, not least diversity of supply sources, which will be essential to ensuring the development of a functional wholesale market in Lithuania.

ANNEX A – CHANGES IN THE MARKET SITUATION IN LITHUANIA

This Annex considers how the market in Lithuania has developed since the decision was taken to develop an LNG import facility in 2012. It is clear why the decision to invest in LNG was taken; to improve security of supply and gain access to competitive market pricing. By 2018, the gas market situation in Lithuania has changed and the decision to continue to invest in LNG may not be as obvious as it was in 2012. However, as we have set out in this report, we consider that the continuation of LNG supply is still in the best interests of Lithuania.

In the following tables, we compare the market situation in 2012, as it is today in 2018 and how it may look in 2025²⁴. We have chosen 2025 as the future point of comparison as it enables us to consider how the market may look if the decision to maintain an LNG facility is taken. In our concluding remarks we also consider how the market may develop if an LNG facility is not maintained beyond 2024.

We examine the market situation from three perspectives:

- wholesale gas market fundamentals;
- regulatory arrangements; and
- establishment of retail supply competition.

²⁴ In our future assessment we have taken a view that the Regional Baltic plus Finland market has been developed and an LNG import facility is maintained. There are, of course, other alternatives that could also be considered.

Wholesale gas market fundamentals

LNG has helped to reduce wholesale market prices and introduce competition into wholesale gas supply. LNG has also improved security of supply and ended the sole reliance on Russian gas supplies. The main features are shown in Table 8.

Table 8 – Wholesale gas prices comparison

Situation in 2012	Situation in 2018	Possible situation in 2025
<ul style="list-style-type: none"> Gas prices based on long-term contract prices indexed to oil 	<ul style="list-style-type: none"> Gas prices reflective of competitive European gas markets 	<ul style="list-style-type: none"> Regional hub prices are converged with European hubs
<ul style="list-style-type: none"> Prices in Lithuania are higher than in other Baltic States and other European gas markets 	<ul style="list-style-type: none"> Gazprom pricing levels competitive with other sources and available on shorter term basis 	<ul style="list-style-type: none"> Regional hub prices are converged with European hubs
<ul style="list-style-type: none"> Marginal prices set by Gazprom 	<ul style="list-style-type: none"> Marginal prices derived from either LNG or Russian gas 	<ul style="list-style-type: none"> Marginal prices set by a number of possible sources depending on seasonality and global LNG prices
<ul style="list-style-type: none"> Single supply source with no alternative supply options 	<ul style="list-style-type: none"> Number of supply sources from LNG – U.S. and Norway LNG cargoes brought in by a small number of Lithuanian players 	<ul style="list-style-type: none"> Gas supply sources are diversified and include pipeline gas from Russia and Poland, and LNG from the US, Norway and other sources LNG spot cargoes delivered to the market and purchased by a number of regional market players
<ul style="list-style-type: none"> No liquidity established in the market 	<ul style="list-style-type: none"> GET Baltic gas exchange established and growing liquidity 	<ul style="list-style-type: none"> GET Baltic exchange is established as the main regional gas exchange

Regulatory Arrangements

Implementation of the Third Energy Package (TEP) has resulted in unbundled market structures and greater regional cooperation. The influence of the European Commission has resulted in changes to Gazprom's pricing policy, at least for the 8 year period expected as a result of the anti-trust case. The main features are shown in Table 9.

Table 9 – Regulatory arrangements comparison

Situation in 2012	Situation in 2018	Possible situation in 2025
<ul style="list-style-type: none"> Security of supply dependent on Russian gas through Belarus and gas storage in Latvia (controlled by Gazprom) 	<ul style="list-style-type: none"> Lithuanian security of supply improved significantly through LNG 	<ul style="list-style-type: none"> Regional security of supply improved significantly through LNG
<ul style="list-style-type: none"> National gas markets 	<ul style="list-style-type: none"> National gas markets but steps are being taken towards a Regional market and greater cooperation between Baltic States at government, NRA and TSO level 	<ul style="list-style-type: none"> Regional market plus Finland is in place creating a single entry/exit zone, harmonised market arrangements and a single trading point Cooperation between NRAs
<ul style="list-style-type: none"> First steps taken towards unbundling of vertically integrated incumbent in Lithuania 	<ul style="list-style-type: none"> Unbundling has occurred in all Baltic States and cross-border trade is possible (although still limited) 	<ul style="list-style-type: none"> Unbundled companies compete in the regional market
<ul style="list-style-type: none"> Latvia and Estonia have derogations from TEP and Gazprom influence remains strong 	<ul style="list-style-type: none"> Implementation of EU network codes in progress 	<ul style="list-style-type: none"> EU network code compliant arrangements are in place
<ul style="list-style-type: none"> National capacity arrangements. Limited cross border flows 	<ul style="list-style-type: none"> Implicit capacity allocation available via GET Baltic exchange 	<ul style="list-style-type: none"> IPs between national markets have been removed
<ul style="list-style-type: none"> No access to LNG possible 	<ul style="list-style-type: none"> LNG supported by regulation in Lithuania relating to the Designated Supplier (DS) and end user purchase obligations 	<ul style="list-style-type: none"> LNG imports lead to removal (or significant reduction) of DS role End user purchase obligations are removed

Establishment of Supply Competition

Whilst competitive markets are becoming established at the wholesale gas market level, further development is required to ensure that retail customers also see benefits. The building blocks are in place to achieve this, but greater competition at the end user level is necessary to ensure that the benefits at the wholesale level are passed through. The main features are shown in Table 10.

Table 10 – Establishment of supply competition

Situation in 2012	Situation in 2018	Possible situation in 2025
<ul style="list-style-type: none"> No supply competition in the market due to vertical integration 	<ul style="list-style-type: none"> Little supply competition established to date 	<ul style="list-style-type: none"> Supply competition developing in the regional market, facilitated by a harmonised wholesale price, common arrangements and reduced barriers Strong regulation still required to ensure that the market operates in end user interests
<ul style="list-style-type: none"> Little scope to develop competition in Baltic States Little/no access to gas storage in Latvia 	<ul style="list-style-type: none"> Regional market prospects improve potential for competition in supply to end users Greater access to LNG supplies, GET Baltic and some storage access 	<ul style="list-style-type: none"> New regional market players have merged and compete with the incumbents, taking market share
<ul style="list-style-type: none"> Gas market liquidity virtually non-existent No transparency or price discovery 	<ul style="list-style-type: none"> Developing liquidity on GET Baltic Growing number of GET Baltic participants Market Makers in place Baltic gas index becoming established, increasing price transparency 	<ul style="list-style-type: none"> GET Baltic provides price discovery which can be accessed by end users
<ul style="list-style-type: none"> No LNG related costs but no benefits of competitive market prices 	<ul style="list-style-type: none"> LNG related costs for end users in Lithuania are still high due to existing arrangements Costs greater than benefits 	<ul style="list-style-type: none"> LNG related costs reduced for Lithuanian end users through new arrangements and a reduced DS role Benefits greater than costs

Conclusions

LNG delivered into Lithuania has helped to address the concerns of security of supply and competitive wholesale gas pricing and has facilitated the changes that have been observed in the gas market since 2012.

LNG continues to play an important role in the gas market in 2018. It is still the only source of non-Russian gas and has enabled the region to end – and maintain - its isolated market status.

The gas market in 2018 has developed since 2012, but there is a risk that some of the positive developments may be reversed if LNG is not continued beyond 2024. If we consider the market in 2025 without access to LNG then the following features may be observed:

- Security of supply would be dependent on GIPL to supply non-Russian sources of gas and whilst this may serve Lithuanian end users, it would not be sufficient to supply the whole region in the case of a cessation of Russian gas supplies.
- The diversity of gas supply in Lithuania and the region will be adversely affected as Poland will provide the only source of non-Russian gas.
- Gas prices may rise above competitive levels seen at European hubs as there are not sufficient gas supply volumes to counter the dominant position of Gazprom in the market. Liquidity in the market is reduced due to a lack of diversity of supply.
- Progress in supply competition is likely to be affected as the wholesale market suffers from a lack of diverse gas sources and competitive pricing.
- Whilst LNG related costs to the Lithuanian end user are removed, higher wholesale gas costs lead to a negative outcome and higher overall prices for end users.

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ANNEX B – SENSITIVITIES

Alongside the analysis explained so far, we have also investigated some sensitivities to show how the results of the CBA would change if we were to alter some of our assumptions.

In particular, we have investigated:

- How the CBA results change in the event that GIPL does not go ahead as anticipated;
- The impact of lower gas demand in Lithuania; and
- The effect of combining the purchase of the existing FSRU with a restructuring of the lease payments due up to 2024.

B.1 GIPL not developed

In this sensitivity, we have evaluated the impact if GIPL (and the corresponding Lithuania-Latvia capacity increase) does not go ahead. Figure 26 shows the RSI for each market with LNG and no GIPL and illustrates that the Baltic Market’s RSI of 0.78 corresponds to a significant mark-up in price due to market dominance, even with LNG.

Figure 26 – Without GIPL: RSI under each market structure and corresponding Lerner Index (in 2024)

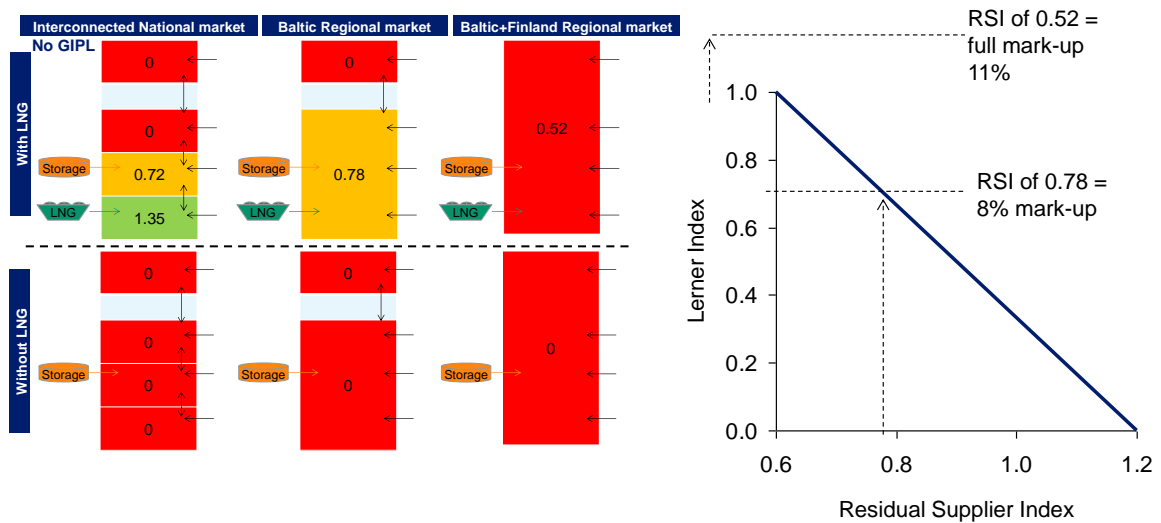


Figure 27 and Figure 28 illustrate the price differences with and without LNG and the corresponding benefits. When GIPL is not present LNG becomes more critical to Lithuania as a national market. However, when the gas market size increases to include the Baltics and Finland the capacity available through LNG alone is not sufficient to remove Russia’s market dominance, so there is no reduction in overall market price and no benefit.

Figure 27 – Wholesale gas market prices with and without LNG (no GIPL sensitivity)

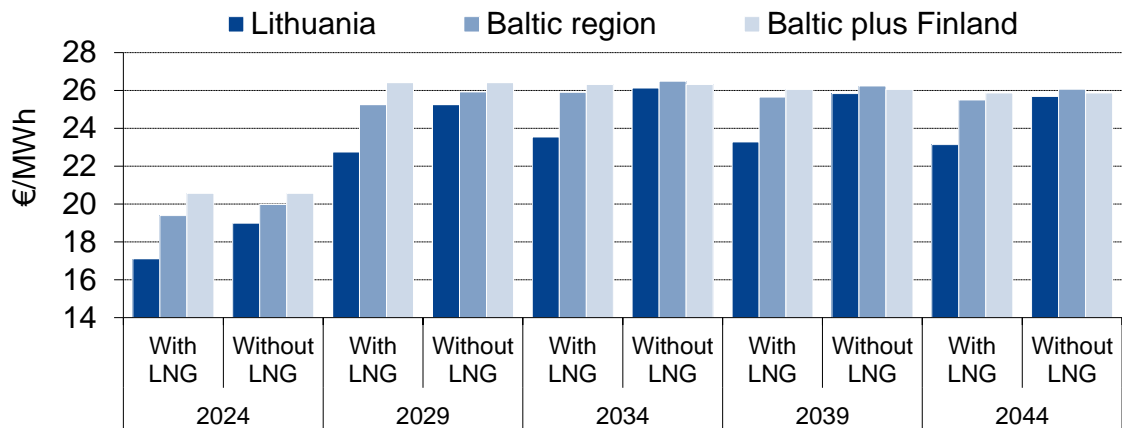


Figure 28 – Benefits resulting from lower wholesale gas price to Lithuania (no GIPL sensitivity)

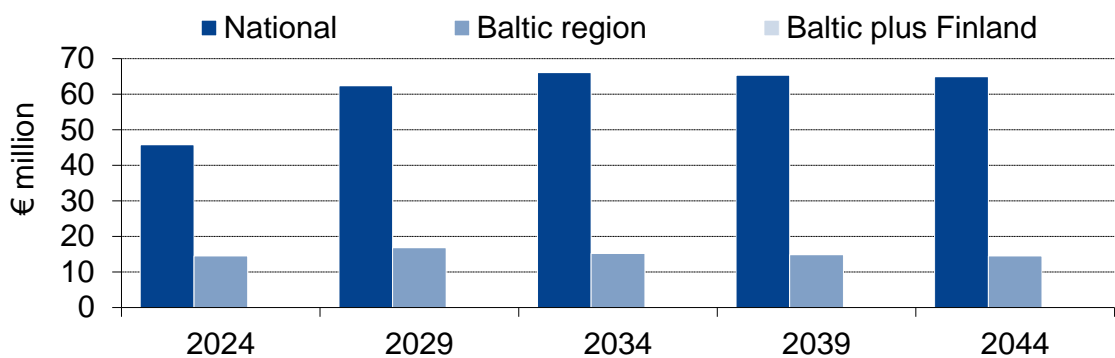


Table 11 – Net economic value (no GIPL sensitivity; €m)

Scenario	Option	National markets	Baltic market	Baltics & Finland
Baseline	Purchase	94.4	406.5	90.8
	Lease 10	14.0	206.8	19.6
	Lease 20	78.5	390.6	74.9
No GIPL	Purchase	386.6	-22.1	-158.8
	Lease 10	190.7	-47.9	-134.8
	Lease 20	370.6	-38.0	-174.7
Difference	Purchase	292.1	-428.6	-249.6
	Lease 10	176.7	-254.8	-154.4
	Lease 20	292.1	-428.6	-249.6

B.2 Lower demand

In this sensitivity, we have assessed the impact of reduced demand for natural gas in Lithuania. We have analysed how the results of the CBA would change in the event that gas demand follows the path outlined by ENTSOG’s Slow Progression scenario. Figure 29 illustrates that with lower demand GIPL provides sufficient supplies to maintain an RSI of 1.10 (in 2024) even without LNG, which reduces the mark-up and hence tempers the benefit LNG provides under the Interconnected National Markets scenario.

Figure 29 – With low demand: RSI under each market structure and corresponding Lerner Index (in 2024)

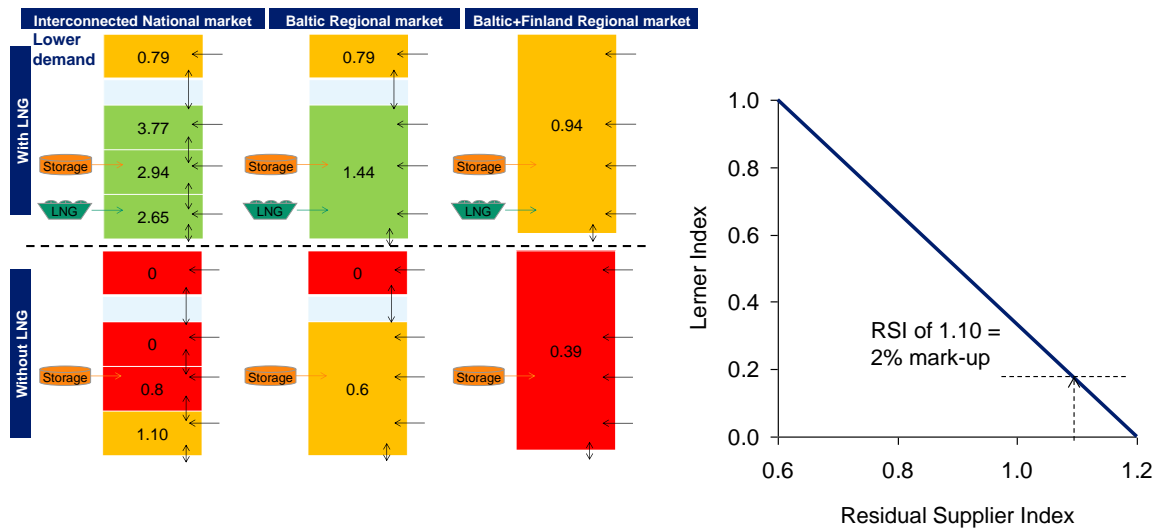


Figure 30 and Figure 31 illustrate the price differences with and without LNG and the corresponding benefits of the low demand sensitivity. The lower level of demand has a marked change in the overall results in the case of the Interconnected National Markets structure, this time showing that all options have a negative net economic benefit for Lithuania.

The range of gas demand in Lithuania is projected to be between 1.9 to 2.3bcm/year over a number of different projections; while the proposed capacity of GIPL is 2.5bcm/year. The ACER methodology applies an availability factor to pipeline capacity of 85% which reduces the annual volumes theoretically available via GIPL to 2.1bcm/year for the purposes of calculating the market’s RSI. Effectively Russia is not a pivotal supplier when Lithuanian demand is 2.1bcm/year or below, when GIPL is operational.

Under all market structures, the benefit for Lithuania from wholesale gas market pricing is reduced since the benefit is multiplied by a lower level of demand. The results for the aggregated demands of the regional Baltic market and the regional Baltic plus Finland market are closer to the previous results and continue to show net economic benefits for Lithuania.

Figure 30 – Wholesale gas market prices with and without LNG (low demand sensitivity)

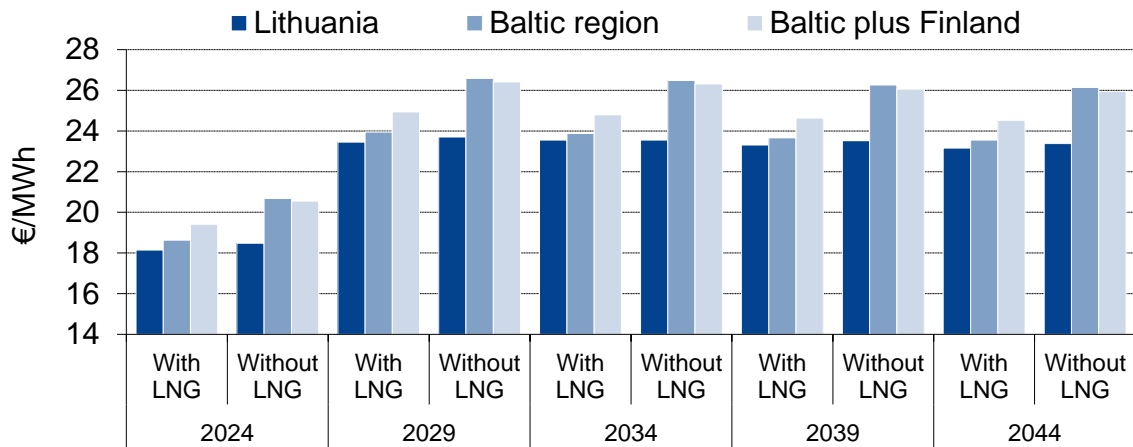


Figure 31 – Benefits resulting from lower wholesale gas price to Lithuania (low demand sensitivity)

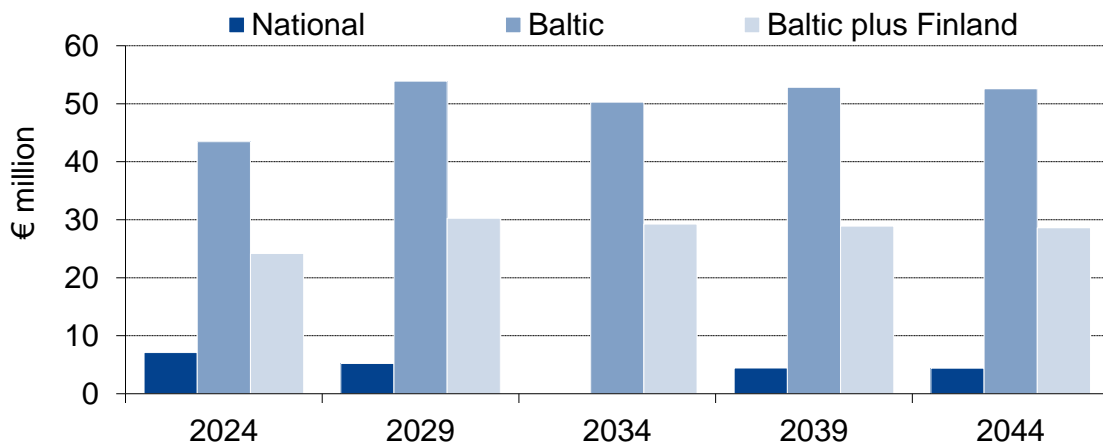


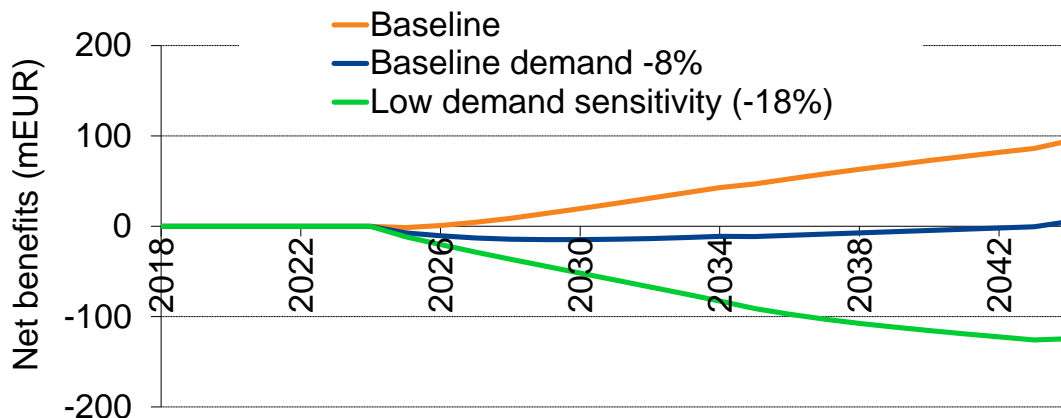
Table 12 – Net economic value (Lower demand sensitivity; €m)

Scenario	Option	National markets	Baltic market	Baltics & Finland
Baseline	Purchase	94.4	406.5	90.8
	Lease 10	14.0	206.8	19.6
	Lease 20	78.5	390.6	74.9
Low Demand	Purchase	-124.3	293.9	95.4
	Lease 10	-111.4	142.2	21.9
	Lease 20	-140.3	278.0	79.5
Difference	Purchase	-218.8	-112.7	4.5
	Lease 10	-125.4	-64.6	2.4
	Lease 20	-218.8	-112.7	4.5

In this low demand sensitivity the Lithuanian demand is on average 18% lower than the baseline scenario.

Since the result is substantially different from the baseline scenario, we have estimated the reduction in demand which would result in a zero net present value. At demand levels 8% lower than the baseline, the CBA results in approximately zero net benefit at the end of the period. Figure 32 shows the net economic benefit under the purchase option and the National Markets scenario for the baseline (Blue Transition) demand, the baseline demand -8% and low demand sensitivity (Slow Progression) -18%.

Figure 32 – Net benefits derived under Purchase and the National Markets scenario for different levels of Lithuanian demand



B.3 Purchase of FSRU together with renegotiated lease

In this sensitivity, we have considered the results in the case that the payments under the existing lease are also renegotiated in 2019 in conjunction with a decision at that date to purchase the FSRU Independence at the end of 2024.

The net present value of the current lease payments until 2024 was calculated using the social time preference rate (of 5% in real terms). The NPV of the existing lease payments

was then converted to a series of annuity payments over the period from 2019 to 2044 using the WACC of KN (5.43%) and added to the annuity payments required to cover the purchase of the FSRU.

As a result, if the payments to Höegh could be restructured in this fashion, although the overall payment is equivalent, there is a net benefit of €24m from the reduction in the fees in the early years which improves the overall cost-benefit result.

Table 13 – Net economic value of purchase together with renegotiated lease

Net benefit (€m)	National markets	Baltic market	Baltics & Finland
Purchase	94.4	406.5	90.8
Purchase with restructured existing lease (5.43%)	118.4	430.6	114.8
Benefit	24.0	24.1	24.0

ANNEX C – COST-BENEFIT ANALYSIS METHODOLOGY

To perform this cost-benefit analysis, we have applied our understanding of best practice and ensured that the evaluation is consistent with the European Commission’s guide to cost-benefit analysis for investment projects²⁵.

Below we outline the principles of our approach and the gas market structures assessed within the analysis.

C.1 Approach

To perform this cost-benefit analysis we have followed the approach outlined below:

- **Identify the problem/reason for intervention:**
 - The expiry of the current leasing arrangements in 2024 provides a clear reason to assess potential options after this date.
- **Identify feasible options:**
 - The options investigated are set out in Section 2 – a set of boundary conditions are developed which are then used to ensure all options put forward are feasible.
- **Identify the time horizon:**
 - The scope of our assignment sets the time horizon to 2044. We have evaluated the costs and benefits over this period, though not all options considered provide the same number of years of operation e.g. in the option where we consider and extension of the lease for 10 years to 2034.
- **Identify the counterfactual:**
 - Since the existing lease will expire in 2024, we defined the counterfactual as a ‘do nothing’ option, i.e. LNG is not available after 2024. Within the counterfactual, we assume that all current arrangements continue until 2024. As a result, Lithuania retains access to LNG (and all consequent benefits) until this time with the current structure of costs.
 - Within the CBA, we then compare other options to the counterfactual, and the result shows the net cost or benefit of retaining access to LNG.
- **Identify the impacts:**
 - Access to LNG is likely to increase diversification of energy supply, increase of security and reliability of energy supply (reduction in supply disruptions) and potentially reduce energy costs.
- **Value / monetise the costs and benefits:**
 - Our approach to monetising the costs is explained in Section 3 and the approach to monetising benefits is explained in Section 4.
 - Qualitative costs and benefits are explored in Section 6.
- **Set the discount rate:**
 - Cash flows are evaluated in real terms (using 2017 as the base year) and then discounted at the Social Time Preference Rate. We have used a Social Time

²⁵ Guide to Cost-Benefit Analysis of Investment Projects, Regional and Urban Policy, December 2014

Preference Rate of 5% as recommended for Cohesion Countries by the European Commission²⁶.

- We have used the ‘Spackman Methodology’ for including investment costs. Under this approach a firm’s financing costs are taken into account by converting the firm’s investment cost into annual payments (an annuity akin to a corporate bond) using the firm’s weighted average cost of capital. The resulting costs are discounted at the Social Time Preference Rate.
- **Evaluate the results:**
 - We evaluate the results in two steps before arriving at our conclusions:
 - firstly, by considering the economic net present value of the results across the range of potential market structures; and
 - secondly, we consider the qualitative costs and benefits, the risks of different options, and the potential for unintended consequences.

C.2 Overview of market structures

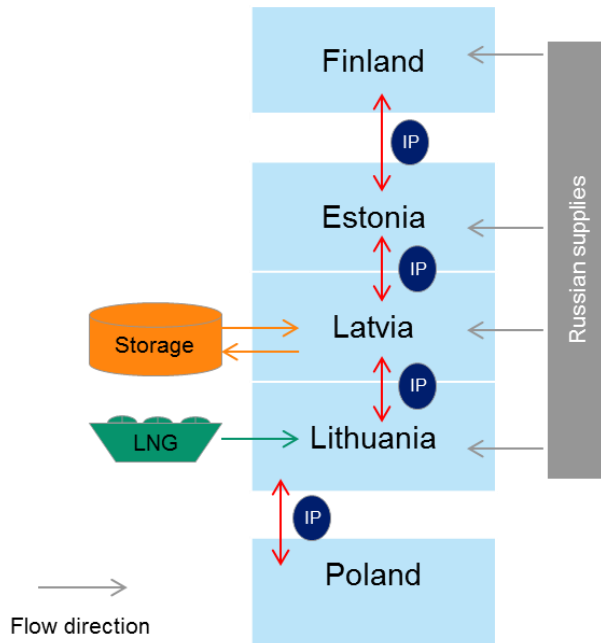
There are a number of possible market structures that may be in place in 2024 which are dependent on the progress of the regional market development. Three market structures which are feasible and which form the basis of our scenarios for investigation in the CBA, are illustrated in Figure 33, Figure 34 and Figure 35.

- **Interconnected National Markets** – the regional market is not implemented and the current national market structure remains. Cross-border gas flows are possible through the booking of capacity at Interconnection Points (IPs) between the national markets. Each national market has its own entry/exit zone and Virtual Trading Point (VTP). Capacity is available from the relevant Transmission System Operator (TSO) and the balancing zone is based on national boundaries. Entry capacity is booked according to tariffs set by each TSO and National Regulatory Authority (NRA) with no harmonisation across national boundaries. Oversight of the national markets is carried out by each of the NRAs.
- **Baltic Regional Market** – the regional market is developed and includes Lithuania, Latvia and Estonia within a single regional entry/exit and balancing zone. A harmonised entry tariff is developed and an Inter TSO Compensation (ITC) mechanism is in place to ensure each individual TSO receives its allowed revenue according to the agreement with each NRA. System operation is carried out by a Market Area Manager (MAM) or some form of regional cooperation between the TSOs.. There are no commercial IPs and no requirement for market participants to book any capacity between Lithuania, Latvia and Estonia. Close regulatory cooperation is achieved by the NRAs to ensure consistency. Finland and Poland are connected to the Baltic Regional Market via interconnections with capacity being booked at the relevant IPs.
- **Baltic plus Finland Regional Market** – the Baltic Regional Market concept is extended to include Finland in an expanded single entry/exit and balancing zone. The IP between the Baltic Regional Market and Finland does not exist in this market structure. The Finnish TSO is included in the MAM or regional TSO cooperation and the ITC mechanism is extended to include Finland. The Finnish NRA cooperates closely with the Baltic States’ NRAs.

²⁶ Commission Implementing Regulation (EU) 2015/207, page 51

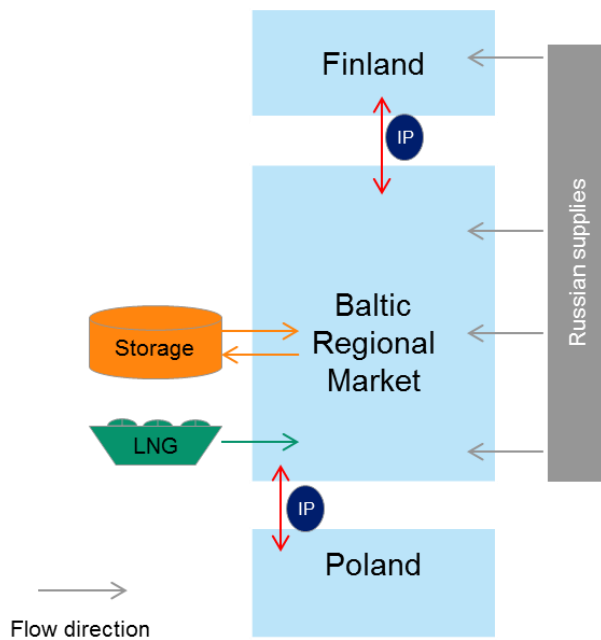
In each of these market structures we assume that the Balticconnector and the enhanced Latvia/ Estonia interconnection is constructed before 2024 to connect Finland and Estonian gas markets. We also assume that the Gas Interconnector Poland to Lithuania (GIPL) and the enhanced Lithuania/Latvia interconnection is constructed.

Figure 33 – Interconnected National Markets



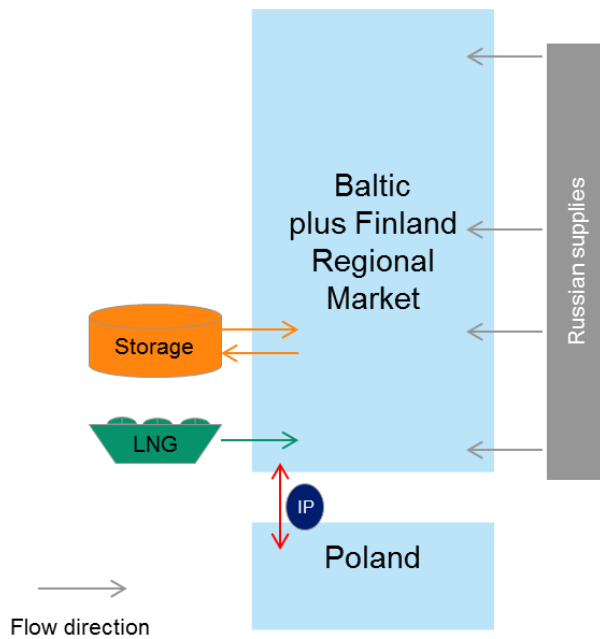
- Separate entry/exit based national markets connected at IPs and subject to EU Network Codes rules
- Tariffs applicable at all IPs and national entry and exit points – no harmonisation
- Each national market has its own VTP
- Finland and Poland connected to Estonia and Lithuania respectively with tariffs applicable at the IPs

Figure 34 – Baltic Regional Market



- Baltic States form a single entry/exit zone
- Tariffs are harmonised at entry points to the region
- No tariffs charged between the Baltic States as IPs are removed
- Tariffs apply at the IPs connecting Finland and Poland to the region
- A single regional VTP is created
- Separate VTP exists in Finland and also Poland

Figure 35 – Baltic plus Finland Regional Market

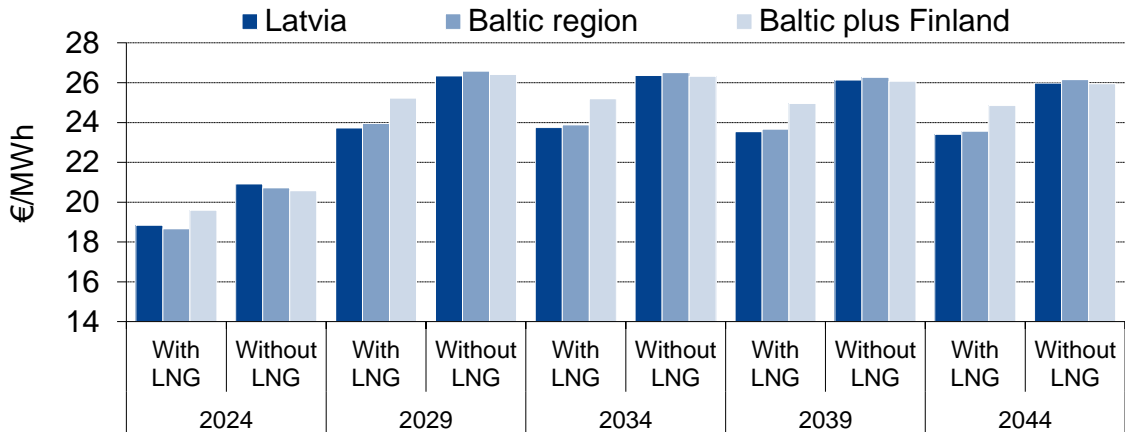


- Baltic States and Finland form a single entry/exit zone
- Tariffs are harmonised at entry points to the Baltic plus Finland region
- No tariffs charged between the Baltic States and Finland as IPs are removed
- Tariffs apply at the IP connecting Poland to the region
- A single Baltic Region plus Finland VTP is created
- Separate VTP exists in Poland

ANNEX D – BENEFITS TO LATVIA AND ESTONIA

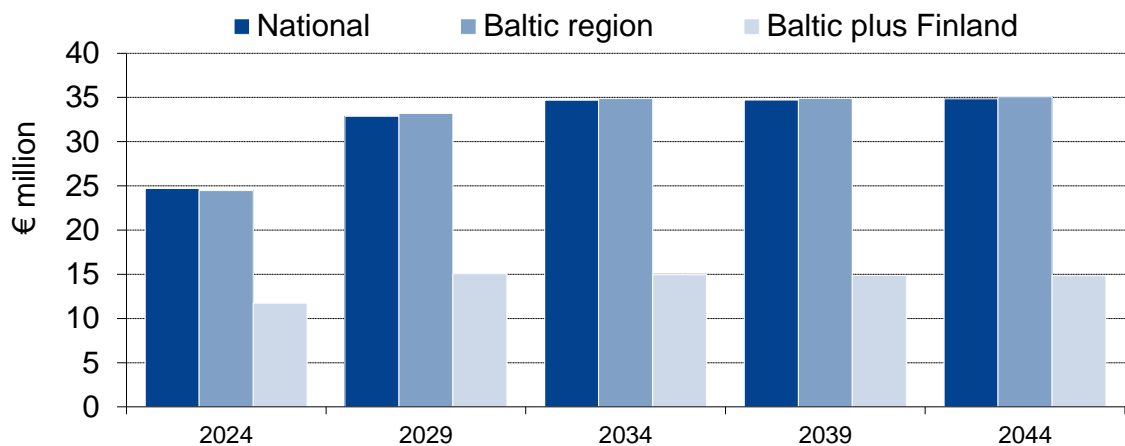
The benefits of LNG extend to the other Baltic markets. In the case of Latvia this is illustrated in Figure 36, showing the increase in prices when LNG is not available. It is also interesting to note that the Latvian market price only changes slightly when it moves from a National market to a Baltic market.

Figure 36 – Wholesale gas market prices with and without LNG – Latvia



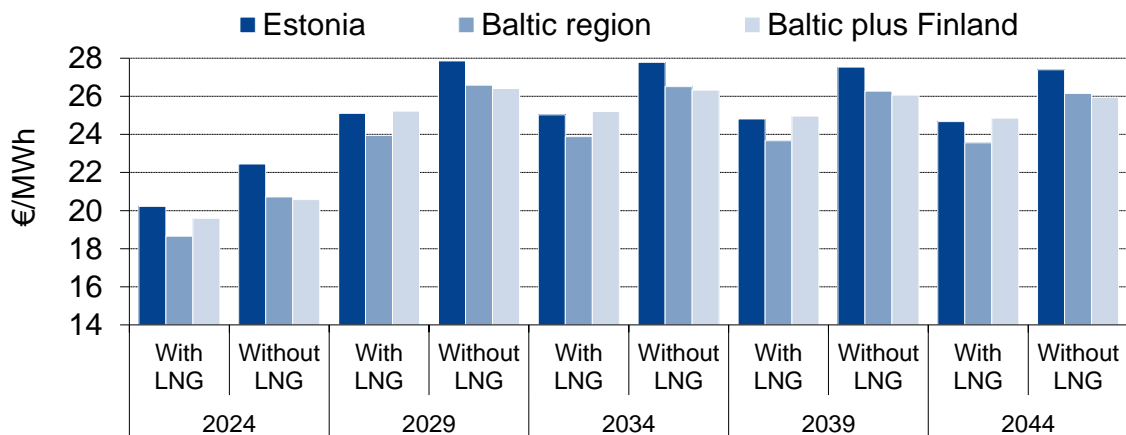
The annual benefits to Latvia are calculated by multiplying the price differential by the market demand, and this results in an annual figure of between €10 and €35 million, shown in Figure 37.

Figure 37 – Benefits resulting from lower wholesale gas price in Latvia



The benefit to Estonia, of lower prices with LNG, are also clearly illustrated in Figure 38, which shows the additional benefit of moving from a national market to a Baltic market.

Figure 38 – Wholesale gas market prices with and without LNG – Estonia



Because of the lower market demand, the total benefits to Estonia are smaller, between €5 and €15 million per annum – shown in Figure 39.

Figure 39 – Benefits resulting from lower wholesale gas price in Estonia

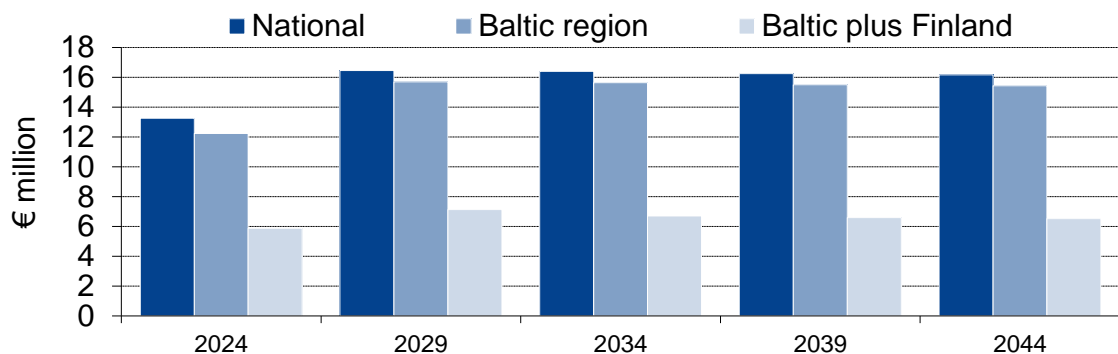


Table 14 illustrates that both Latvia and Estonia will also receive a net economic benefit from Lithuania retaining access to LNG. We assume that Latvia and Estonia bear no costs for the terminal, so all benefits are retained. All the costs are borne in Lithuania and this explains why the net economic value is higher in Latvia than in Lithuania in 2 of the 3 market structures. Within the table, we assume that Lithuania selects the option which delivers the highest net economic value (i.e. purchase of a FSRU).

Table 14 – Summary of net economic value to Lithuania, Latvia and Estonia

Net benefit (€m)	National markets	Baltic market	Baltics & Finland
Lithuania	94.4	406.5	90.8
Latvia	289.5	291.4	128.9
Estonia	140.8	134.0	59.4

ANNEX E – STAKEHOLDER ENGAGEMENT

As part of our analysis we have consulted with a number of stakeholders in the region. These have included gas market participants, LNG importers and regulatory authorities. Below, we summarise the general themes and issues but we do not attributed specific views to individual stakeholders.

In general, the discussions with the stakeholders confirm the view that the LNG terminal in Klaipeda has had several beneficial impacts on the Lithuanian gas market. The responses can be grouped into the following areas:

- **Competition in the wholesale gas sector:**
 - Access to LNG has enabled a variety of sources of gas to compete in Lithuania. This has resulted in opportunities to import LNG at times when this is cheaper than pipeline gas, and also exerts a competitive pressure on the pricing of pipeline imports from Gazprom. In return, pipeline gas acts as a ceiling for the price which parties are prepared to pay for international LNG.
 - Competition introduced to the market by LNG was generally viewed as an effective way to ensure there is no abuse of a dominant position into the future. But it was also clear that this was not the only way to improve the competitiveness of the market. Other events such as EC influence and anti-trust proceedings, as well as the end of long-term contracts and action by the Lithuanian government had all had an impact on Gazprom's behaviour.
 - There is some confidence amongst market participants that gas prices will, in future, continue to be based on/linked to international prices and that this is an important benefit, as is the opportunity to use Western European hubs for hedging.
 - End users will only see a benefit if supply competition is fully established. Wholesale market competition is a facilitator of supply competition but it is not the only factor that needs to be addressed. Some changes to the regulations in Lithuania may need to be changed to ensure supply competition as a chance to become established.
 - Whilst the development of GIPL will provide another supply source, this will not replace the requirement for LNG. Firstly, the capacity of GIPL is not sufficiently large to make a real difference to the region. Secondly, concerns were raised over the establishment of a competitive market in Poland – although we did observe a difference of opinion on this.
- **Cost of LNG infrastructure:**
 - The existing arrangements relating to LNG impose a considerable cost burden on the users of gas in Lithuania.
 - Currently the costs may outweigh the wholesale gas price benefits for the end users in Lithuania – since the gas prices charged by Gazprom are now much lower than in the past.
 - Some concerns were expressed as to whether there are effective incentives in place to reduce its costs as far as possible.
 - Recovering the costs through direct usage fees of the terminal would provide a disincentive to use the facility and would potentially result in benefits leaving Lithuania (since pipeline gas would only need to compete with the cost of international LNG plus the terminal charges).

- **Security of supply:**
 - Almost all stakeholders agreed that access to LNG improves the security of supply for energy in Lithuania.
 - The benefit which LNG brings will be diminished once GIPL provides further import capacity.
 - The benefit which LNG provides has been ‘theoretical’ in the sense that Russia has proved to be a reliable partner which has resulted in practically no loss of supply in recent years.

- **Demand for gas:**
 - The long-term role for gas in a decarbonising world is not certain. In particular a large percentage of demand in Lithuania comes from one company, so the requirement for gas infrastructure is heavily dependent on the plans of that company.
 - Demand growth is only likely in the transportation sector, and potentially though increasing access to gas in areas which are not currently served by the gas grid.
 - Demand growth in the power sector is likely to be limited:
 - Lithuania currently imports large quantities of electricity from Nordpool at relatively low prices (low enough that neither gas-fired generation nor merchant renewable generation can compete).
 - The draft Energy Strategy foresees substantial growth in renewable electricity generation. Gas-fired generation is likely to be required to provide ancillary services, but this will result in increased peak-day requirements rather than substantial annual demand.
Since there is little domestic generation at present, gas-fired generation does not represent a substantial opportunity to decarbonise.

- **Regional market:**
 - There were a range of views of the impact of a regional market.
 - It is viewed as a positive step by most stakeholders as it would result in a larger market area with a greater potential for the development of liquidity and supply competition.
 - A regional market could increase the utilisation of an LNG terminal as transportation charges from Lithuania to the other Baltic States would be reduced.
 - Most comments related to the benefit that Lithuania achieves being closely linked to the allocation of costs across the relevant markets. In most cases, the expectation seemed to be that Lithuania would see little (if any) benefit since it already has access to LNG and to storage in Latvia, so a net benefit would only be achieved through the LNG costs being shared with the other nations.

- **Klaipeda terminal:**
 - The current terminal causes some logistical issues (for example, the working gas volume is small relative to the size of Lithuanian demand, which requires frequent cargoes if running at full capacity).
 - Some of the costs of the terminal (e.g. network reinforcement, jetty, etc.) are sunk, so would need to be recovered even if the facility were closed (and incurred again if an alternative site were proposed).

- If a new/replacement terminal were built in Latvia, Estonia or Finland, there would be network reinforcement necessary to address a bottleneck in southern Latvia if Lithuania were to enjoy unfettered access.
- The FSRU has supported innovation into ssLNG and trucking of gas to previously off-grid areas.
- **Future of the LNG terminal post 2024:**
 - Some market participants were not sure if the terminal would continue to offer a benefit after 2024 as this is after their normal outlook for gas sourcing.
 - Other stakeholders had more confidence that the terminal would continue to offer benefits and should be maintained due to diversity of supply and competition benefits. Security of supply continues to be an issue post 2024 even with GIPL in the supply mix.
- **Unintended consequences:**
 - Support for gas may limit opportunities for renewable growth in Lithuania.
 - Support for gas may adversely affect the Lithuanian oil refinery utilisation – especially if ssLNG grows.

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